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CONTRIBUTIONS.—Subscribers and others will materially assist in making our news accurate and complete if they will send early information of events which take place under their observation. Discussions of subjects pertaining to all departments of railroad business by men practically acquainted with them are especially desired.

ADVERTISEMENTS.—We wish it distinctly understood that we will entertain no proposition to publish anything in this journal for pay, EXCEPT IN THE ADVERTISING COLUMNS. We give in our editorial columns OUR OWN opinions, and these only, and in our news columns present only such matter as we consider interesting and important to our readers. Those who wish to recommend their inventions, machinery, supplies, financial schemes, etc., to our readers, can do so fully in our advertising columns, but it is useless to ask us to recommend them editorially, either for money or in consideration of advertising patronage.

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VOL. XLIII., No. 11. FRIDAY, SEPTEMBER 13, 1907.

We reprint this week, by permission from the *Quarterly Journal of Economics*, a remarkable paper by Professor Mitchell, of the School of Commerce, Accounts and Finance, of New York University. The author has given a scholarly and thorough history of the Union Pacific and the growth of its financial operations, and has covered his subject far more fully than it has ever been covered before. In this period of rapid corporate expansion the story of the last ten years of Union Pacific development has been partially obscured by the multitude of other interesting events which have forced themselves upon the observer's attention. It is highly important therefore, that the salient facts of this development should be placed upon record, and we congratulate Professor Mitchell upon the manner in which he has performed the task.

The butting collision of electric cars near Charleston, Illinois, August 30, resulting in the death of 14 persons, is charged by a coroner's jury to the negligence of both motormen. As a number of passengers testified that there appeared to have been time for a material reduction of the speed of the passenger car, the motorman of that car may perhaps be justly blamable, for it is said that he, as well as the other motorman, jumped off without so much as turning off the power; but the other car—an express car, not a passenger car—was running on the time of the passenger car, and the real fault lies at the door of the man who was responsible for this irregular use of the track. A motorman may, indeed, be blameworthy for wasting a few seconds in an emergency, when he ought to apply brakes instantly; but as the ability to *save* seconds when one is facing danger is not an art that can be taught by the superintendent or prescribed by a court, it is puerile to talk of punishing by law a man who lacks such ability. The reports indicate that the superintendent or despatcher told the man in charge of the express car to keep out of the way of the passenger car, but failed to add that the passenger car was, on that day, on account of a fair, making round trips every 30 minutes instead of one in 45 minutes, as was customary. These instructions were given over the telephone line and were not written down. This collision will doubtless confirm in their objection to the telephone those railroad officers who hold that it is not a safe means of transmitting train orders; but it seems quite clear that the fault was not with the mode of communication, but with the failure to have orders written out, repeated and approved after repetition. Intrusting an order to one man (the motorman alone), instead of to two, appears also to be a fault of the system practiced on that road. In short, the same bad practices would have been almost or quite as easy with the Morse telegraph. It is not the telephone that has developed the weakness of the despatching system. The only safe system is the block system.*

W. A. Garrett, President of the Seaboard Air Line, acting as arbitrator in the matter of freight car service on the Long Island Railroad has decided that after November 1 the "switching reclaim" by which that short terminal railroad is now partly recompensed for the excessive cost and delay incident to moving freight on its Brooklyn lines shall be abolished; and that in place of it freight rates shall be readjusted so as to give that company $2.35 a car more than it now receives. This amount equals 50 cents a day for 4.7 days, which the records show to be the average time occupied by each loaded car moving in switching service on the Long Island tracks in the Greater New York district. This is an eminently wise decision. It is based on the only rational plan of adjusting the car service rate to the transportation rate. Car service rates must be as nearly uniform as possible in order to keep the clerical machinery of the car-record offices in working order. A sufficient number of exceptions to a uniform rule would cause the whole scheme to break down. And to be uniform the rate must necessarily be arbitrary. To base the car service rate either on the cost of the service or on what the traffic would bear, would result in almost as many rates as there are transactions; that is to say, scores or hundreds of different rates on the same car within the same year. The car service rate being arbitrary, the only way to make adjustments where it is burdensome is to increase the price for the work done by the cars. The only practicable and rational relief from the arbitrariness of the interchange car-service rate is for each of the roads participating in a joint service to furnish its fair share of the cars to be used in that service. Such an adjustment is not perfect, but it is the best that has yet been thought of. If a road cannot or does not furnish its share of the cars it is face to face with the problem of increasing its charge to shippers, if necessary, to compensate for the extra cost of doing business with hired cars. Mr. Garrett's decision is dated August 22, and is published in the September issue

*On the application of the two companies Judge Craig, at Mattoon, Ill., Sept. 5, appointed W. P. Avey receiver for the Central Illinois Traction Company and the Mattoon City Railway Company. It was on the Central Illinois line that the collision occurred, but the two companies are controlled by the same men and work together. E. A. Potter, of Mattoon and Chicago, is president of each line, and Judge Peter S. Grosscup, of the United States Circuit Court, is the principal stockholder in the two companies.

of the *Railway Equipment Register*. He was chosen by the Long Island Railroad and the General Managers' Association of New York City. The chairman of this association is Vice-President Besler of the Central of New Jersey, and the secretary is W. F. Allen. Mr. Garrett's decision is short and logical. He first shows that the Long Island Railroad participates in the through rate, and therefore should not be allowed a reclaim on freight cars. Reclaims have been allowed there for five years; but, according to the rule, they are intended only for cars which are switched by roads not participating in the joint freight rate. He then quotes from a statement of Chairman Hale that the reclaim, an arbitrary arrangement, is often unsatisfactory and always unscientific. Mr. Hale believes that "the day will come when all switching reclaims can be wiped out and the transportation rates revised to cover real terminal expenses." The New York, New Haven & Hartford delivers freight at Long Island City and the Long Island Railroad there accepts it and adds its own local rate. Why cannot other roads adopt this plan? But, whether they do or do not, the only way to settle this question and settle it right, is to do whatever is possible to carry out Mr. Hale's prediction; and that is the gist of Mr. Garrett's verdict.

The notice, which was given by the New York, New Haven & Hartford last June that it would withdraw from the Per Diem Rules Agreement October 1, was still in force at last accounts; and all efforts at a compromise on the rate to be charged for interchanged cars having been thus far fruitless, the western connections of the New Haven have given it notice that after the withdrawal becomes effective, freight for its lines will be received, transported and delivered as heretofore, unless declined by the New Haven company; but that on cars thus delivered to the New Haven road "you will be charged such sum per day as is reasonable for the use of each car for the period the same shall remain on your lines; and payment thereof will be insisted on accordingly." The committee appointed on behalf of the American Railway Association to negotiate with the New Haven consisted of Messrs. Atterbury, of the Pennsylvania; Smith, of the New York Central, and Hale of the Baltimore & Ohio. This committee suggested that the questions at issue be arbitrated, but the New Haven declined and made the alternative proposition that it should be allowed two days' reclaim, beginning October 1 and continuing until the road has received 8,500 new cars which it has ordered; after the receipt of these cars the other roads to accept a sufficient number of New Haven cars to equalize the per diem payments, this arrangement to continue for one year. The New Haven has ordered 17,000 cars to be delivered by May 1, next. The committee declined this proposition and proposed instead that the connecting roads agree to begin at once to equalize equipment on a monthly basis, leaving all questions concerning the per diem rate to arbitration. The New Haven road declined this, insisting that, until its new cars could be put in service, it was entitled to some compensation. The committee then suggested to the other roads the form of notice referred to above; and this form has been adopted, we understand, not only by all of the immediate connections of the New Haven but by a number of other roads as well. This notice seems eminently fair. These roads cannot take the responsibility of obstructing the enormous movement of traffic from the West to New England over the New Haven road by requiring the goods to be transferred at New York to New Haven cars, though under the circumstances they would have the technical right to do this. In offering to let cars go through for "a reasonable sum per day" they are giving the New Haven full opportunity to show, if it can, that fifty cents a day is exorbitant. But if the burden should lie on the New Haven (as we suppose it would) to prove any rate named by the car owners unreasonably high, the New Haven would have another aspect of the case to consider; for unless all signs fail cars will be worth at least a dollar a day within the next month or two—and perhaps much more than that.

The public service commission of the state of New York has issued an official interpretation of the law relating to the inspection of locomotive boilers that went into effect on July 1. It is well that this should be done, for the wording of the law is such that an overzealous and ill-informed person in authority might easily interpret it in such a way that its execution would be a burden to the railroads, as well as an impossibility. The law says in substance that these boilers shall be thoroughly inspected once every three months. If a thorough inspection were to be understood to be the removal of tubes and an inspection of the inside as well as the outside of the shell, it would probably require at least twice as many engines as are now in use to meet the requirement. As it is, the commission simply requires that the boilers shall be washed out and the staybolts inspected in the time named, and that the thorough inside and outside inspection shall be made at least once in three years. As a matter of fact it will probably appear to most of the mechanical officers of the roads affected, that the regulations for the care and inspection of boilers that have just been issued, have been taken from their own regulations on the subject. There is not a single requirement that can work a hardship in any way and, with the exception of the method of keeping the records, there will be little, if any, change in the present workings. It looks as though these regulations had been compiled from the best of those current on all of the roads. In a few instances men will find that the time of inspection has been shortened. For example, it is required that "safety valves should be tested at least once every month, and no boiler must be used over three months under any circumstances unless the safety valves have been thoroughly tested." It often happens, at present, that safety valves are not inspected and tested between shoppings, but the engineman is required to report those that do not work properly, and this means a constant supervision of the matter. Another regulation is that gage cocks and glasses shall be cleansed whenever the boiler is washed. This is often neglected, and dependence is placed on the fact that they are working and nothing further is done. It is merely an additional precaution and will require but little time to meet. In this interpretation the commission has set the stamp of its approval on the use of the tell-tale hole in staybolts and made it a requirement that cannot be omitted unless the railroad company can show very good evidence that its methods of testing are so thorough as to obviate the necessity for such a precaution. This will probably result in the universal acceptance of the hole, in spite of the fact that some still consider it useless. In the same way the methods of testing staybolts are set forth, and as these are the methods followed in the majority of cases, it will probably lead to uniform practice in this respect also. With the exception of these minor matters, which are already embodied in the practice of some roads, there is nothing in the regulations that need do more than attract a passing notice. It looks very much as though somebody was pushed to it for a law to regulate the railroads, and so one was passed that might have been construed in such a way as to be a hardship, if a wise commission had not taken it in hand and simply set up good current practice, stamped it with the seal of official approval and sent word to the railroads that they were doing well, and that if they continued in the same way there would be no occasion for complaint.

THE NOISE NUISANCE.

With the return of the season of wide-open bedroom windows come renewed complaints of all kinds of noise nuisances, and the newspapers of the past two months have contained the usual editorials and local items on the subject. The railroads come in for at least their regular share of the growling, and in some cases an increased share, this because engines are larger and louder and more numerous and also, apparently, because engine runners are flagrantly careless in the use of whistles and bells. It would seem that in the great expansion of business many superintendents have promoted firemen more rapidly than they have trained them and instances are not wanting where the discipline of the runners of a given division appears to be poorer than it was five or ten years ago.

Complaints of noise reach railroad managers in an irregular stream and usually receive only intermittent attention; so that, like some other reforms which are regarded by everybody as of secondary importance, this reform makes only halting progress. And yet every superintendent is ashamed of his noisy engineers, whenever their slipshod conduct comes under his own personal notice, and if he happens to be out on the road in his private car, or in a sleeper at night, with members of his own family, or their friends, his shame leads to brave resolves to cure the nuisance. Why, therefore, should not there by an improvement? Surely the feelings or wishes of women and invalids residing near a freight yard, and doomed to stay there 24 hours a day, and especially if they be too poor to escape by moving to some other locality, ought to have as much consideration as those of people who are troubled only occasionally. Moreover, anything that is done in this line must be managed as for an all-the-year-round campaign. Sensitive ears suffer in winter as well as in summer. To make enginemen careful

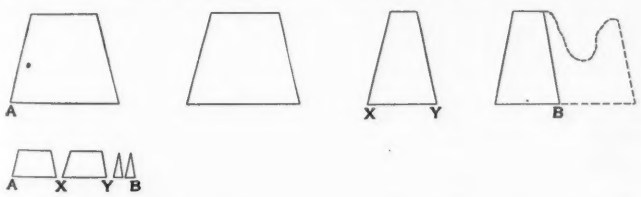
it is necessary to "surprise-check" their management of whistles, bells, air pumps and other noise producers twelve months in the year. A circular issued in the spring is not enough—is, in fact, not worth the cost of printing it, unless it is followed up by personal attention to the matter.

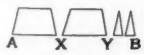
That the noise made by locomotives is as bad now as ever it has been before, seems a pretty safe assumption. Besides the weakness of discipline just mentioned, the increase in the size of engines and of air pumps, and in the number of trains run, helps to swell the total volume of noise. (Air pumps are often allowed to make a great deal of unnecessary noise in train sheds.) The abolition of crossing whistles where grade crossings have been done away with appears to be the only important exception to this statement. But whether the nuisance is larger or smaller it demands abatement to the fullest possible extent.

The noise made by locomotives is often great enough to be a nuisance even after everything possible has been done to lessen it, and this is the real reason why some railroad officers neglect their duty regarding it, but it is not a good reason. Following this line of argument, we should not subdue bells and pop valves around sleeping cars at night. In point of fact the respect shown for the rights of sleeping passengers is the best example we have of rational and restrained use of locomotives and their whistles and bells; and all that a superintendent needs to do, in most cases, is to enforce as good a degree of care at other times and places as he does in this particular.

The problem, therefore, is simple and we have no editorial exhortation to offer. The manager who has many engines, or even a single sleeping car, and who keeps in close touch with his road knows whether or not his passengers and his (the railroad's) neighbors are accorded as considerate treatment as he would like to have accorded to his own family. But we do wish to set forth a few flagrant instances. Some superintendents evidently do not know how great a nuisance some of their enginemen are, or else don't care. In a recent hundred mile trip on a fast train of one of the best trunk lines, the writer rode in a coach next to the engine; and, with the other passengers, was forced to listen to four long ear-piercing shrieks of the whistle at every crossing; and there were somewhere from 20 to 50 crossings. The whistle blasts were not only twice as loud and four times as long as was necessary, but were also of all sorts of lengths. The engine driver was one of those unsensitive, unmusical men who seem to have no delicate idea of time and who therefore make —— ——— ——— —— and other combinations for —— —— — — with as cheerful persistency as though they were eliciting applause at every repetition.

Another experience that compelled a poor opinion of the railroad superintendent was that at a summer resort near the main-line of an important railroad in Massachusetts. Although a mile from the track, outrageous whistling of the freight locomotives was noticeable day and night, particularly in the early morning and late at night. The needlessly large size of the whistles on the engines and the carelessness of the enginemen, were equally annoying. The excess, both in volume and length of sounds, may be approximately indicated by the accompanying diagrams. In both





diagrams the horizontal measurement represents time and the vertical measurement represents volume of sound. Both diagrams are designed to show two long blasts followed by two short ones, the usual whistle signal for a highway crossing. The smaller one represents the signal as given on an ordinary whistle in about two seconds' time (A B—2 seconds); the larger shows how it was usually made on these engines (A B—9 seconds), by runners who had no thought of the comfort of residents along the line, sick or well, old or young, asleep or awake. Eight or nine seconds was a common length of the crossing signal. Often they would take more time than that. Most of them, like the runner before mentioned, took little care to graduate the length of the blast according to the rule. One runner, apparently wishing to indulge his fancy or to distinguish himself by something that would seem prettily characteristic, would put a flourish on at the end somewhat as indicated by the dotted line in the larger drawing. One night about midnight the whistle of a passenger train—not so loud and shrill as the whistles on the freights—was sounded continuously for about 12 or 15 seconds.

The remedy for such slovenly work, as we have said, is obvious. The main question is as to how earnestly the division superintendent desires to apply it. As every energetic superintendent makes an improvement in this matter when complaint is made by his wife's sister, or by some cousin of the president of the road, it would seem to be the part of wisdom for ordinary citizens or boards of aldermen who desire to secure action, to enlist the co-operation of such relatives; or else to try to imitate their method—which is nothing more than direct appeal, persistently repeated as many times as may be necessary. It is quite certain that a city council cannot make much headway by passing ordinances, unless it is prepared to forbid all whistling; for where any at all is to be permitted it is necessary that the enginemen exercise their judgment, and defective judgment can rarely be corrected by ordinance. There is, however, one way in which city authorities can do some good, and that is by publicly recognizing the sufficiency of bells and the non-necessity of whistles, where the circumstances warrant taking such a stand. The laws of some of the states—notably Massachusetts and New York—require as a signal at highway crossings the sounding of either the whistle or the bell, but do not require both. The persistent use of the whistle, everywhere, to-day, after experience has demonstrated in so many situations the sufficiency of the bell alone, is due largely to the feeling among railroad officers that they must do more than the law requires of them. Innumerable lawsuits have resulted in awards of damages to persons injured at crossings who failed to heed a reasonably loud warning, and the railroad officer in such cases has naturally determined to clear his own skirts for the future by having all warnings made unreasonably loud. He persists in this until the noise becomes intolerable to himself, unless some state or municipal authority publicly approves of an abatement of his zeal.

The most obvious lack in the remedial measures usually adopted by superintendents is their neglect to clinch their instructions. To actually effect the reasonable limitation of the use of whistles it is necessary not only to issue to enginemen an order—which will be obeyed for a short time by nearly all and thereafter by only a few—but to tell them how to carry it out and then watch and see how well they obey. Proper lengths of blasts can be put in force only by a regular teaching process. On the Fitchburg road a dozen years ago an electric buzzer was used by the instructor and men were taught by example—not by circular—that the highway crossing signal could and should be made in 2½ seconds; and at the same time they were shown that "two-long-and-two-short," meant what it said, and that four blasts of irregular lengths—with occasional two-second intervals between blasts—did not come within a mile of complying with the rule. Unfortunately, that Fitchburg superintendent went "higher up" and his graduates seem to have all died and to have left no successors. That buzzer, with the right kind of a man back of it, is needed to-day in five hundred trainmasters' offices.

Two other simple things might be done. Most locomotive whistles will give an adequate signal for a crossing, or for almost any purpose, if opened only half way. It would be easy to arrange the whistle-pull so that ordinarily it would give only a soft blast, while yet leaving the engineman free, by a more energetic movement, to pull the valve wide open. Or, a single rod or lever could be made to sound a soft and mild whistle and then, by a further stroke, to sound an additional whistle, doubling the volume of sound.

The second point is to give premiums. One of the most satisfactory details of American railroad operation is the payment of prizes in the roadway department, with the emulation and excellence thereby secured; why should not this advantage be secured in other departments? A good record in noiselessness is hard to define, in giving instructions or advice to an engineman; but with a proper incentive he will very readily define it to himself. Premiums are peculiarly adapted to secure excellence in matters which cannot be suitably described in written orders. Where good service depends, not on an improvement of knowledge or skill, but on a more lively motive, a premium is often the best or only means available. As may be noted by observing the movements of engines in any busy train shed after 10 o'clock at night, the maintenance

of a tolerable degree of quiet depends on a number of other things besides the right use of whistles; and a premium covers these other features of the problem as nothing else will. By first giving a premium—or good pay—to others to report careless or noise-loving enginemen, premiums to enginemen for clean records could be made to work an improvement in a very short time. Of course, we are not considering train sheds, or cities, particularly. Many long-suffering country people deserve to have their rights recognized.

NEW PUBLICATIONS.

Allowable Pressures on Deep Foundations. By E. L. Corthell. New York: 1907.: John Wiley & Sons. Cloth, 98 pages and tables. Price, $1.25.

This book is a reprint of a paper read before the Institute of Civil Engineers, London, in 1906, which was prepared after the author had made a study of foundation pressures in connection with harbor improvement work at Rozario, Argentine Republic, in 1902-1903. The allowable pressures on the footings of a proposed quay wall resting on the tertiary sand in the bed of the Paraná river were under consideration by the advisory board of engineers of which the writer was chairman, and wide differences of opinion arising, an investigation of recent practice in this detail of design was begun. The data, obtained through circular letters to prominent engineers all over the world and from articles in the technical press, were compiled in the form of brief descriptions of important works and in a long table giving the essential details of practice. This work was done under the direction of Mr. Corthell, by C. R. Wychoff, Jr., of Columbia University. The appendix contains brief descriptions of 54 engineering structures involving deep foundation work. In the table, the data for 178 structures has been collected. The pressures per sq. ft. safely employed in different soils as shown by the tables are as follows: Fine sand, from 2.25 tons to 5.80 tons, average 4.50 tons; coarse sand and gravel, from 2.40 tons to 7.75 tons, average 5.1 tons; sand and clay, from 2.5 tons to 8.5 tons, average 4.9 tons; alluvium and silt, from 1.5 tons to 6.2 tons, average 2.9 tons; hard clay, from 2.0 tons to 8.0 tons, average 5.08 tons; hard pan, from 3.0 tons to 12.0 tons, average 8.7 tons. The average pressures given above are low and safe pressures lie somewhere between the average pressures and the maximum pressure in each case.

The Bond Buyer's Dictionary. Edited by S. A. Nelson; 1907 edition. 174 pages; 5 x 7¼ in.; cloth. Price, $2.00. S. A. Nelson & Co., Inc., 116 Nassau street, New York.

This is a compilation of facts and opinions about bonds of various sorts which Mr. Nelson has been seven years in collecting. It is largely made up of extracts from papers like the *Wall Street Journal* and the *Railroad Gazette*, and from articles by various men who are authorities on financial matters. There is little original work in it except in the editing and combination of these various materials. The book is divided into seven parts, as follows: Government Bonds; Municipal Bonds; Railroad Bonds; Real Estate Mortgage Bonds; Industrial and Public Service Bonds; Underwriting and Distributing Bonds. The most important of these is the section on Railroad Bonds. These are described under a great number of different heads which are generally in no special way related, but each a brief summary of information on one point. The book is well worth reading for any one who does not understand the principles of bond issues and bond investments, and it is a convenient collection and summary of information for all who are interested in bonds.

Self-Propelled Vehicles. By James E. Homans. New York: Theo. Audel & Co. Cloth, 644 pages.

The automobile is a complex machine and to the layman difficult to understand in its workings. The multiplicity of details and the difficulty of clearly explaining in language as non-technical as possible the construction and operation of many of them make the writing of a layman's text book no easy task. The author of this book has succeeded well, however. With the aid of more than 500 illustrations and diagrams, the essential details of steam, electric and gasolene automobiles are described in simple language, easily understood. Some of the best known makes of machines are described as a whole, together with the method of operating them. One of the most interesting chapters is on the history of self-propelled vehicles from the time of Cugnot's steam wagon in 1770 down to the practical application of the high-speed gasolene motor about 1885 by Gottlieb Daimler. The book will be found particularly useful to owners of automobiles and prospective purchasers.

On the Art of Cutting Metals, by Frederick W. Taylor, M.E., Sc.D., which was the Presidential address presented at the last annual meeting of The American Society of Mechanical Engineers, has been reprinted and bound in cloth by the society, price $3. This or any other publication of the society may be had by addressing the Secretary, 29 West 39th street, New York. It is not necessary to send orders through members. None of the publications of The American Society of Mechanical Engineers are copyrighted.

CONTRIBUTIONS

A Theory Concerning the Cause of the Quebec Bridge Failure.

Chicago, Sept. 7, 1907.

To the Editor of the Railroad Gazette:

The accounts which have been published of the failure of the Quebec bridge generally refer to the slightly buckled condition of one of the lower chord members of the anchor span in the third panel out from the main post, the impression given being that this condition was the initial cause of the failure. There is no evidence to support this, other than that the member ultimately failed. To be sure this member shows evidence of being crippled by an extraordinary load, and there is no doubt that all of the members in the anchor arm were subjected to the same conditions at the instant of failure, but it so happened that this member had an initial distortion, so that at the instant of failure it absorbed the bulk of the great dynamic energy of the falling cantilever arm. The fact that the structure, as a whole, dropped vertically, points to other causes for failure than the collapse of a single member in one truss.

In all cantilever bridges with curved chords, during the process of erecting the bridge an anomalous condition arises with regard to the web members when the traveler stands out on the end of the cantilever arm. Similar conditions may arise in a finished structure, but in the Quebec bridge, at the time of the failure, this condition was intensified by the presence of two travelers on the end of the cantilever arm, and at the same time a large part of the fixed load in the floor was omitted. In other words, the condition of the loading which produces large pier moments with comparatively small shearing forces, in a cantilever arm with curved chords, develops a very critical condition in the web members near the tower unless these members are qualified to resist either tension or compression.

In the Quebec bridge, beginning at the tower, the first diagonal web member on each side of the tower is a stiff member. The remaining diagonal members to the end of the cantilever arm are purely tension members. What point is the criterion of these members for the condition existing at the time of the failure? To be sure, the designer of this bridge made a stress diagram for the conditions covering the erection of this structure, but were those conditions faithfully carried out? Did he provide for one traveler or two travelers on the bridge at the same time? Did he assume the distribution of the fixed loads correctly? Were the shipping weights of the finished members the same as the calculated weights, within reasonable limits? All these things and many more militate against him, and unless he fully appreciates the gravity of the case he will go astray. Now, what can happen if all this is not provided for? If the stress diagram shows a member near the tower just at the point of turning from tension to compression, or neutral, this member is in a very critical condition when the chords have an extreme curvature. Any departure from the loading assumed, especially at the criterion, works for or against him as the load is increased or diminished at that point. Any slight deviation may mean failure in case the member under consideration is not capable of resisting either tension or compression.

Now, what can happen in case the load on a web member is such that it cannot resist? If the member is an eye-bar and the load is compression, the member will shirk its duty and allow the bottom-chord joint to rise. This will occur simultaneously in both trusses, bringing a bending action on the chord sections, and thereby delaying momentarily the fall until they finally yield and allow the arm to drop. At the same time the tower posts will be pushed in at the bottom and pulled out at the top, dragging the anchor arm with them, so that the top chord eye-bars will be strung out on top of everything else, just as shown in the views published. To be sure, the anchor arm collapsed, but at the same time it was dragged forward, as is clearly shown by the fact that the portal now lies midway between the anchorage and the main pier where the top chord eye-bars begin.

All this argument can be answered by the designer of the bridge, who has all the data at hand, and the writer suggests that he publish a stress diagram giving the stresses in the cantilever arms to correspond as nearly as possible to the conditions existing at the time of the failure of the bridge.

J. W. SCHAUB,
M. Am. Soc. C. E.

Which Is the Best Electric Railroad System?

New York, Sept. 9, 1907.

To the Editor of the Railroad Gazette:

Electrification is a very actual question for many railroads, and electrical engineers in general are enthusiastic in stating what electricity can do. But they have of late been talking almost too much about the advantages which one particular electric system is supposed to possess as compared with all other systems. And in view of the many widely different statements made in this connection, it is difficult for the average railroad man to form an opinion

concerning the advisability of using electricity as motive power on his road. The following is written as an attempt to assist in understanding the differences, real and imaginary, between the three rival electric railroad systems.

With few exceptions electrical engineers are distinctly given to praising their pet system as being by far the best for every purpose, and all other systems they consider impracticable, or at least uneconomical and otherwise defective. Now, the fact of the matter is, that each system has distinct advantages and disadvantages. It all depends on the viewpoint chosen. Indeed, it is very easy to prepare hypothetical cases in order to show that under certain conditions one particular system is far superior to everything else. But it is a distinct mistake to judge from such a demonstration that the particular system is the best for all railroad purposes. It is, on the contrary, an absolute requirement that each electrification problem be studied on its own merits, and that system should be adopted which best meets the special conditions under consideration. There is no such thing as a universal electric system, but an analysis of the entire electric railroad problem will give some idea as to the greater or lesser fitness of the various systems for certain different classes of service. Let us therefore first look at the foundation of the matter.

It is probably admitted to-day that it is possible to build electric locomotives to handle any traffic now handled by steam locomotives. But where does the use of electricity as motive power begin to be profitable? This seems to be quite distinctly a question of adequate return on first cost of installation.

On steam railroads the motive power equipment is concentrated in the locomotives. On an electric railroad it comprises three distinct parts—the electric power house, the conductors along the line and the locomotives. Take any railroad now operated by steam locomotives and the first cost of an electric equipment suitable for handling the same traffic will be in the great majority of cases in excess of the first cost of the present steam equipment.

Nevertheless, the use of electricity as motive power is justified in all cases where either one or all of the following conditions are fulfilled. First, where governmental action, or the willingness of passengers to pay more for electric traction, make electrification imperative or advisable; second, where the increase in traffic capacity, due to electric locomotives, makes up for the increased fixed charges on the larger investment; third, where the savings effected by electric operation are in excess of the increased fixed charges.

The first condition is exceptional and needs here no special consideration. The second condition is fulfilled on all those roads where the traffic density is nearing the limit of what can economically be handled with steam locomotives. In these cases the greater acceleration and the higher running speeds feasible with electric locomotives will make it possible to handle from 30 to 50 per cent. more traffic without adding new tracks, and the additional investment for electric equipment is generally only a fraction of what new tracks would cost. The third condition is found principally on roads with comparatively heavy grades, or with other features limiting the useful output of the steam locomotives. The greater power of the electric locomotives will make it possible to run trains over grades at the same speeds as on the level, without the use of pushers, and the savings thus effected, together with the savings due to smaller maintenance costs of electric locomotives will frequently much more than counterbalance the new fixed charges due to additional investment.

In many cases, for instance, where grade reductions are contemplated to increase the traffic capacity of any given line, two or more conditions are found together, and in such cases the use of the more powerful electric locomotives will not alone decrease operating expenses materially, but will also save the entire new investment for reducing the grades. The electric equipment will thus pay for itself over and over again.

The general problem of trunk line electrification is therefore quite distinctly the problem of finding the most powerful locomotive. Through increase in tractive power of locomotives it is possible to increase the traffic capacity of the road, or decrease the operating expenses, or both.

Now, let us see how the various electric traction systems meet this condition. There are three distinct systems: First, the well-known continuous current system, introduced into practice by the Grand Master of Electric Traction, Frank J. Sprague, on the historical Richmond road over twenty years ago, and since then successfully used on many thousands of miles of road and more recently for the important electrification work of the New York Central's New York City terminal; second, the single-phase alternating current system, brought out about five years ago by B. G. Lamme, installed during the last few years on a number of interesting interurban railroads and exemplified for the heavier work by the equipment which the New York, New Haven & Hartford has just put in service on a first section of its line between New York City and Stamford, Conn.; third, the three-phase alternating current system, thus far not well enough known in America, but successfully used in Europe for the past fifteen years, among other places for the well-known high-speed tests between Berlin and Zossen, and for all recent heavy electrifications, the Simplon Tunnel, the Giovi line, near Genoa, and others, the first American installation of this system being the equipment of the Cascade Division of the Great Northern now in course of construction. Each of these three rival systems comprises the three parts of the motive power equipment mentioned above—namely, the electric power house, the conductors along the line and the locomotives. In a comparison of the systems it is feasible to take up one of the parts after the other.

First the power house. With the distances to be covered in trunk line work and the amounts of power involved, it is indispensable that the power house be arranged to produce electricity at high pressures. In the continuous current system it is possible to employ several power houses along the line, each producing continuous currents at pressures up to, say 2,000 volts or somewhat more. But in general this does not prove advantageous, and the usual practice in all three systems is to have a central power house generating three-phase alternating currents at reasonably high pressures, up to, say 50,000 or 60,000 volts, according to the distance to be covered, which high pressure three-phase currents are then transformed for use on the locomotives into low-pressure currents, continuous or single-phase or three-phase, as the case may be. The size of the power house depends, above all, on the amount of energy required at the axles of the locomotives throughout the day; that is, on the weight, number and distribution of trains, on the speed at which they are moved, and on the grades they have to overcome, but furthermore also on the efficiency with which the electric energy is transmitted to the locomotives, and by them transformed into mechanical energy for the purpose of turning the wheels. As regards energy required at the axles, the three systems are pretty nearly on a par, though special conditions, such, for instance, as the use of energy made free on trains descending a grade, may sometimes favor one system over the other. On the question of efficiency of transmission much has been said and written, but not much actual data is thus far at hand. On comparatively short lines, up to, say 20 miles long, the single-phase and the three-phase alternating current systems can feed the locomotives direct from one central power house without the use of sub-stations. In such cases they are almost unquestionably more efficient than the continuous current system, which must of necessity use either sub-stations or else several smaller power houses to cover the same ground. But a very careful investigation into this matter leads me to believe that under ordinary conditions the total efficiency of the three systems is not much different, though the losses occur in each one at different points. Generally speaking the three systems may therefore be assumed to call under similar conditions for power houses of approximately the same size and approximately the same first cost.

Coming to conductors along the line, we find greater differences between the three systems. By conductors we shall understand all that is required to conduct the energy from the power house to the locomotives. To collect, say 2,000 h.p., with 2,000 volts continuous current pressure, means the handling of about 700 amperes. With 5,000 volts single-phase alternating current or 3,000 volts three-phase alternating current it means the handling of about 300 amperes. A pressure of 2,000 volts is pretty close to the upper limit for continuous current operation, while 5,000 volts is not by any means the limit for alternating current operation. The collection of anything above, say 300 amperes from an overhead line at railroad speeds, creates difficulties. It is therefore easy to see that for heavy work the continuous current system will probably be forced to use a third rail, while the single-phase and three-phase alternating current systems can use overhead wires or third rail as may best suit the conditions. For a given current density the pressure of the single-phase system has to be 1.73 times the pressure of the three-phase system. On long roads, or wherever the pressure generated in the power house differs from the pressure used in the locomotives, sub-stations are necessary. The two alternating current systems use stationary transformer sub-stations to change from high pressure to low pressure alternating currents. The continuous current system has to use rotary converter or motor generator sub-stations to convert the high-pressure alternating currents into low-pressure continuous currents. Converter sub-stations are unquestionably more expensive than stationary transformer sub-stations. The costs of first-class third rail and overhead wire installations are taken by the best authorities as being pretty nearly equal, perhaps with a slight advantage in favor of third rail. We find, therefore, that on short roads, where sub-stations are unnecessary, the first cost of the conductors along the line may be taken as being almost the same for the three systems. On longer roads, where sub-stations are required, the cost of the conducting system between power house and locomotive becomes more expensive for the continuous current as compared with the two alternating current systems, and, on account of the higher pressure required, probably also more expensive for the single-phase as compared with the three-phase system.

Coming to the locomotives, we find very material differences between the various systems. Take as examples of each kind, the New York Central continuous current locomotive, the New York,

New Haven & Hartford single-phase alternating current locomotive and the Italian Simplon three-phase alternating current locomotive. Designed and built at pretty nearly the same time and for very similar service, they may well be directly compared with one another. They are similar in that all three weigh about 95 tons and have their axles direct driven by the electric motors without any intermediary gearing. But there the similarity ends. The New York Central locomotive has four continuous current motors of 550 h.p. each, or a total of 2,200 h.p. The New York, New Haven & Hartford locomotive has four single-phase alternating current motors of 250 h.p. each, or a total of 1,000 h.p. The Simplon locomotive has two three-phase alternating current motors of 1,500 h.p. each, or a total of 3,000 h.p. The above ratings of the motors are based on the standard one hour test, accepted by electrical engineers as giving probably the fairest basis of comparison; in other words, the motors are capable of exerting the output mentioned above for one hour continuously without heating any of their parts more than 75 deg. C., which is considered a reasonable temperature for railroad motors. For short periods all of the three locomotives will be able to exert very much larger powers, the maximum output of the continuous current motors being probably about 4,000 h.p., that of the single-phase alternating current motors about 2,000 h.p. and that of the three-phase alternating current motors about 8,000 h.p. The continuous current and the single-phase alternating current motors are of the so-called "Series" type, their speed varying in inverse proportion to the load, being a maximum with light loads and dropping off as the load increases. The three-phase alternating current motors are of the so-called "Synchronous" type, and will run at any desired speed, it being immaterial whether the load increases or decreases. This may be an advantage or a disadvantage according to conditions. Structurally there is this to be said about the three types of motors. For light traffic they are probably equally reliable. For handling very heavy trains, the single-phase alternating current motor is open to objections, because its inherent characteristics make it impossible for the single-phase alternating current motor to exert while standing still a long and steady pull without serious injury to its winding. The single-phase alternating current locomotive is therefore exposed to danger if called upon to hold a heavy train on a grade or to start a train from rest in cold weather, etc. The three-phase alternating current motor is unquestionably the most robust of the three, and the entire absence of any commutators in the three-phase motor will undoubtedly be highly appreciated by all who know what it costs to maintain commutators in railroad service. But, aside from the above-mentioned limitations of the single-phase motors, it may be said that either type of electric locomotive is to-day probably at least as reliable and accident-proof as a steam locomotive. At any rate the companies manufacturing electric locomotives are strong enough to back up any guarantees they may care to give to that effect. The efficiencies of the three types of motors will probably be pretty nearly the same in general service. The continuous current motors will likely show a somewhat better efficiency where trains make frequent stops, as is the case in suburban passenger service. On the other hand, the three-phase alternating current motors will unquestionably be the most efficient for heavy grade work, because they automatically recuperate the energy made free by the trains going down grade. When the weight of locomotives is compared with the output, we find the following: Based on the one hour rating the continuous current locomotive produces 23.2 h.p. for each ton of locomotive weight, the single-phase alternating current locomotive 10.5 h.p. and the three-phase alternating current locomotive 31.5 h.p. The weight efficiency of the three types is therefore very materially different and, inasmuch as the cost is closely proportional to the weight, the same amount of locomotive power will cost most in the single-phase alternating current locomotive, less in the continuous current locomotive, and least in the three-phase alternating current locomotive, more or less in the above proportion of weights per horse power.

Having thus investigated the characteristics of the three parts comprised in any electric system, we are now in a position to judge with greater accuracy what are the chances of the three rival systems for adoption in heavy electric traction work. I repeat, it is dangerous to generalize and each case must of necessity be treated individually and in great detail. Yet it is quite permissible to draw the few general conclusions which follow:

As regards power house there is a slight advantage with the continuous current system for very short lines, and with the single-phase and the three-phase alternating current systems for medium and long lines.

As regards conductors the three systems are fairly equal for the short lines, and there is an advantage with the single-phase and the three-phase alternating current systems for medium and long lines.

As regards locomotives the three systems are equal for light trains and long runs over a fairly level profile. For heavy trains the advantages are with the continuous current and the three-phase alternating curent system. For frequent stops the advantages are with the continuous current system. For grade work the advantages are with the three-phase system.

The comparisons are admittedly crude. But they seem to confirm pretty plainly the general opinion that the particular field of the continuous current system is short distance work, both heavy and light, freight and passenger. The field of the single-phase alternating current system is long distance work of the lighter kind, such as interurban passenger service. The long distance heavy work, or the real trunk line work, is quite plainly the field of the three-phase alternating current system, both from the cost standpoint and because the three-phase system has the most powerful locomotive.

It is, of course, up to the engineer to decide whether any given road may justly be classified in one of these three categories, or whether it belongs to two or more or them at the same time. In the latter event the advantages presented by one system for part of the service may be more than counterbalanced by the advantages presented by some other system for the rest of the service. A careful and detailed investigation, considering all of the points involved, will usually bring out very plainly the system which presents the greatest advantages all around.

In any case it is well to remember that the differences between the three systems are, after all, not fundamental, but rather differences in details, just as an electric power house can be built to generate electricity by the use of a reciprocating engine, a steam turbine or a gas engine, and, aside from the differences in unit costs, the results will be pretty nearly the same in either case. It might be well, therefore, to close these lines with a word of admonition to electrical engineers in general, not to fight too much among themselves on the question of which system is the best, but rather to concentrate their forces on the supplying of general data on the electrification problem as such, so that we may all see the day brought nearer when electricity will be used as motive power on every road where it should be thus employed.

C. L. DE MURALT,
Of Muralt & Co., Engineers, 114 Liberty St., New York.

A Detachable Voucher Draft.

BY FRANK H. CRUMP,
Assistant to the Auditor; San Pedro, Los Angeles & Salt Lake Railroad.

The present voucher draft used in settlement of accounts is objectionable for several reasons. It contains one or more awkward folds. When a large account is stated in detail one or more sheets are added, which makes a cumbersome document to pass through the banks and gives information about quantities and prices which it is sometimes not desirable to make public. The voucher draft, a drawing of which is shown herewith, has been designed in order to overcome these objections. The upper two divisions of this drawing show the statement of account and the detachable draft. The lower part of the drawing shows the bottom of the duplicate sheet which goes to the auditor. The rest of this duplicate sheet, which is concealed by the statement of account and the draft, is similar to the statement of account and is blank in the space covered by the draft. The triplicate sheet is the same as the duplicate sheet.

It will be noted that the original is perforated between the draft and the voucher statement, which are to be torn apart by the payor before mailing them both to the payee. On receipt of these documents the payee checks the voucher statement with his records and retains it for future reference. The draft is then deposited for collection. Under this method the banks handle a standard form of draft without any papers attached, and the statement of account, containing one or more sheets, remains with the payee. This idea of making a draft detachable is entirely new.

Many railroad companies have refused to adopt the ordinary form of voucher draft because it is likely to give disinterested persons unnecessary information. As a substitute the ordinary voucher requiring the receipt of the payee is most commonly used. This is sometimes paid by a bank check or where the information shown on the voucher is unimportant, made a sight draft by the use of a rubber stamp, reading as follows:

> When properly receipted this voucher becomes a sight draft, payable through ..... Bank.

In the first case, where payment is made by check, the bank handles the check only, but the payee has to endorse the check and also receipt the voucher. The latter the payee frequently fails to do, until a special request is made by the payor, and in many cases the original voucher is lost and duplicates are prepared and receipted. In some cases the payee cannot be located and the bank check remains as the only receipt in the hands of the payor. When vouchers are made sight drafts by a rubber stamp, it is necessary for the banks to open and examine them very carefully, and for that reason this form of voucher draft is objectionable. The new form of voucher draft can be freely used in payment of all accounts without disclosing information as to price details. Assignments, releases, contracts, deeds, agreements, etc., can be signed in the usual way and reference to them shown on the voucher statement.

As it is impracticable to show full detailed information on every

IF TWO OR MORE SHEETS ATTACH HERE WITH GUM OR FASTENER AND FOLD BENEATH

_____ VOUCHER _____ SHEET NO. 1 TREASURER'S DRAFT NO. _____
(MONTH) (STATEMENT) (DEPT. NO.) (VOUCHER NO.)

THE EAST AND WEST RAILROAD CO. _____ 190__

To DR.

EXAMINED AND REGISTERED JOHN DOE, AUDITOR PER _____

COUNTERSIGNED

_____ VOUCHER NO. _____ TREASURER'S DRAFT NO. _____
MONTH

THE EAST AND WEST RAILROAD CO.

CHICAGO, ILL. _____ 190__

PAY TO THE ORDER OF _____ $ _____

_____ DOLLARS

IN FULL SETTLEMENT OF THE ACCOUNT STATED ON VOUCHER OF ABOVE NUMBER.
VOID UNLESS COUNTERSIGNED BY H. W. JONES AND PRESENTED WITHIN THIRTY DAYS FROM ABOVE DATE.

TO RICHARD ROE, TREASURER
PAYABLE THROUGH
_____ BANK

_____ AUDITOR

DISTRIBUTION

ACCOUNT	AMOUNT	ACCOUNT	AMOUNT

CORRECT	APPROVED	EXTENSIONS AND FOOTINGS CHECKED
APPROVED	APPROVED	VERIFIED AS TO CONTRACT, ETC. AUDITOR'S CLERK
	GENERAL MANAGER	AUDITOR'S CLERK

SPACES BELOW ARE FOR DEPARTMENT DATING STAMPS

(1)	(2)	(3)	(4)	(5)

A Detachable Voucher Draft.

Original form and lower part of duplicate form are shown.

voucher, it is the usual practice when an invoice covers a number of items, to refer to the invoice date or number as a means of identifying the account which the voucher pays. The identification of the new draft and voucher statement shown is made in the same way. The draft refers to the number of the voucher which contains the statement of account. The draft states explicitly that the money is received "in full settlement of the account stated on voucher of above number," thus connecting the instrument by which payment is made, with the account whose payment it covers. This is the essential feature of the new form.

At first this may seem to be a good deal of a departure from the present practice, but a moment's thought will convince under the present system when there are too many accounts to be listed on a single sheet, two or more voucher sheets are used, the total being carried forward. In such cases the receipt or draft portion on the additional voucher sheets is canceled or cut off. The receipt or draft which is used reads "In full settlement of the account stated above," when, as a matter of fact, the account is only *partially* stated *above*, the rest of the account being stated on a separate sheet or sheets. In the detachable voucher form the principle of identification by a number has been applied to all accounts. The account is stated on one document and the draft in payment of the account on another document, each referring to the other. The bank endorsements fully protect the payor on all drafts paid through the banks, and proper endorsement is secured on all drafts paid in cash.

In using the detachable voucher draft the department preparing the voucher fills in on a typewriter the voucher number, payee and account on the upper part, and the voucher number, payee and, in figures and in writing, the amount on the lower part. The stenographer, without removing the voucher from the machine, inserts the distribution of the expenditure in the space provided on the duplicate in plain view of all who handle the voucher. The voucher is then press-copied, which sets the ink and prevents alteration of the number, payee and amount on the statement of account and also on the draft. When designed, a triplicate copy may at the same time be made for the department pre-

DISTRIBUTION OF DEPARTMENT VOUCHERS PAYABLE MONTH OF _____ 190__

VOUCHER NO.	AMOUNT	DISTRIBUTION — ACCOUNT AND AMOUNT									

Auditor's Record of Distribution of Voucher Payments.

AUDITOR'S VOUCHER REGISTER MONTH OF _____ 190__

DEPT. NO.	DATE REGISTERED	NO.	FAVOR OF	FOR	AMOUNT	DISPOSITION		DATE AND HOW SETTLED		
						TO WHOM SENT	DATE SENT	BY DRAFT	VOUCHER MONTH	VOUCHER NO.
[FOR NOTCHING]										

Auditor's Register of Vouchers Paid by Detachable Voucher Draft.

paring the voucher, the duplicate being forwarded to the auditor.

The original voucher is folded over the duplicate, to which are attached all supporting papers, making a compact document which may be quickly handled by officials whose signatures of approval appear on the duplicate as the auditor's authority for payment of the account. When vouchers pass through two or more departments, the department dating stamp, which is usually shown on the back of vouchers, is on this form shown on the *face* in department order.

When the voucher reaches the auditor it is verified and registered and the signatures of the clerks who perform these duties shown in space provided. The draft is then signed by the auditor and the original voucher and draft are detached and forwarded to the treasurer.

When the treasurer is ready to pay the account the draft is numbered, dated and the name of the bank on which it is drawn inserted. The draft is then countersigned by the treasurer, cashier, teller or other authorized official. The draft portion should then be detached from the statement of account and *both* mailed to the payee. When the draft is returned through the bank paid, a bank check should be given to cover the drafts presented each day. This method of paying vouchers materially reduces and simplifies the work of the disbursing office.

The forms used for the records kept by the auditor in using detachable voucher drafts are shown herewith. The auditor's register of vouchers payable should be kept by departments, as shown on this form. The sheets should be printed on one side only, bound on the right-hand margin and notched on the left-hand margin for department number.

A separate sheet should be used for each department's vouchers, and all vouchers entered in numerical department number order, which should also be the auditor's number. Each department should keep each month's account separate and begin each month's vouchers with number "I." Each department should be assigned a department number to be used in connection with the voucher number. For example, if the store department has department number 1, all vouchers issued by that department should be numbered 1—1, 1—2, etc.

The auditor's record of the distribution of department vouchers payable is also shown. This is made up by each department which issues vouchers. This method puts each department in close touch with its own expenses and saves the auditor the labor of making a voucher distribution.

The distribution furnished by each department should be verified by the auditor with the distribution shown on each voucher, and balanced with the total vouchers issued by each department, as shown on the register of vouchers payable. As vouchers are paid, the date on which each is paid should be stamped in the column provided and at the close of the month a detailed statement made of vouchers still unpaid, which should agree with the balance "vouchers payable" on the general ledger.

The Traveling Engineers' Association Convention.

The Traveling Engineers' Association held its fifteenth annual convention at the Auditorium Hotel, Chicago, September 3 to 6, inclusive, President W. J. Hurley (N. Y. C.) in the chair. The association was welcomed by E. J. Brundage, Corporation Counsel of Chicago, representing the Mayor. W. A. Gardner, Vice-President of the Chicago & North-Western, delivered an address. The association now has a total membership of 632. The following committee reports and individual papers were presented for discussion:

1. To locate fault of engine not steaming without moving draft appliances.
2. Eliminating the smoke nuisance on soft coal burning engines.
3. Advantage of the hot water system of washing out and filling boilers.
4. Lubrication of cylinders and valves of locomotives using saturated and superheated steam.
5. Waste of energy in railroad operation.
6. Advantages of mechanical stokers as compared with hand firing.
7. What is required of the air-brake to properly control the trains of to-day and what has been done by railroads and manufacturers to meet these requirements?
8. Superheated steam and how to get good results with it in service.

There were morning and afternoon sessions on two of the four days of the meeting, so that plenty of time was allowed for the discussion of each subject. Extracts from two of the more important reports were printed last week and others will be given in a future number.

The officers for the ensuing year are: A. M. Bickel (L. S. & M. S.), President; J. A. Talty (D., L. & W.), First Vice-President; C. F. Richardson (St. L. & S. F.), Second Vice-President; F. C. Thayer (Southern), Third Vice-President; W. O. Thompson (N. Y. C.), Secretary; C. B. Conger (I. C. S.), Treasurer.

The Growth of the Union Pacific and Its Financial Operations.

BY THOMAS WARNER MITCHELL.

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At midnight of January 31, 1898, the Union Pacific Railroad system emerged from one of the most drastic reorganizations hitherto known in railroad finance. Its growth and activities since that date have also been the most remarkable, perhaps, in corporate history. An account of these will be attempted in the following pages.

Since the organization of the present Union Pacific Railroad Company in July, 1897, there have been three fairly well-defined periods in the system's development. During the first period, which extended from the date of organization to, say, December 31, 1900, the company confined its activities in the way of expansion mainly to bringing back under its control those auxiliary systems and branch lines which had been parts of the old Union Pacific, but which during the receivership period of 1893 to 1897, inclusive, had been torn out and reorganized separately. The second period began early in 1901 with the Union Pacific's attempt to gain control of Northern Pacific, and thereby a one-half interest in the Chicago, Burlington & Quincy. Growing out of this attempt, and belonging to this period, were the formation of the Northern Securities Company, the subsequent decision by the United States Supreme Court that this company was a combination in restraint of trade and illegal, and the redistribution to its stockholders of the Great Northern and Northern Pacific stock which it held. The gradual sale by the Oregon Short Line of its portion of these shares, and its subsequent large purchases of Alton, Atchison, Baltimore & Ohio, Illinois Central, New York Central, North-Western, and Chicago, Milwaukee & St. Paul stocks are the important events of the third period. Running through all three periods are the extensive activities of the Union Pacific in the betterment and equipment of the lines of its system.

I.

ORGANIZATION AND RECONSTRUCTION, 1897-1900.

A brief description of the Union Pacific system as it existed in 1893, just before the receivership, and of its subsequent dismemberment, will assist to an understanding of the events of the first period.

The old Union Pacific Railway Company was organized in 1880 as a consolidation of the still older Union Pacific Railroad Company, whose main line extended from Council Bluffs, Iowa, to Ogden, Utah, a distance of 1,043 miles; of the Kansas Pacific Railway Company, whose main line, lying about 100 miles to the southward, connected Kansas City with Denver, Colo., a distance of 643 miles; of the Denver Pacific Railway & Telegraph Company, whose 104 miles, extending almost north and south, connected the Kansas Pacific at Denver with the Union Pacific at Cheyenne, Wyo.; and of a small branch line. These lines, aggregating 1,821.86 miles, were owned in fee simple by the Union Pacific Railway Company.

Through the ownership of $15,116,703 out of $26,244,853 of the capital stock of the Oregon Short Line & Utah Northern, and through the ownership by this company in turn of $14,508,200 out of $24,000,000 of the capital stock of the Oregon Railway & Navigation Company, the Union Pacific exercised control of the 1,425 miles of the one and 1,059 miles of the other, and gained an outlet to Portland, Ore., and the Pacific ocean. Also through the ownership of $13,251,882 out of the $32,634,482 of the capital stock of the Union Pacific, Denver & Gulf Railway, the Union Pacific exercised actual control of that company's 1,463 miles of railroad, extending the Denver Pacific from Denver southeasterly to Fort Worth, Texas.

In addition to these extensions the Union Pacific owned a majority interest in, and in many cases all of the stock of, about 25 branch lines and systems of various lengths. The largest of these were the Omaha & Republican Valley Railway, 482 miles; the Denver, Leadville & Gunnison Railway, 325 miles; the St. Joseph & Grand Island Railroad, 251 miles; the Central Branch Union Pacific, which with its leased lines aggregated 388 miles; and the Union Pacific, Lincoln & Colorado Railway, 225 miles.

Altogether the Union Pacific Railway Company controlled or owned 7,681.72 miles of railroad. In the case of the branch lines it owned not only most of their capital stocks, but in many cases a large part or even all of their bonded debt. By 1893, however, all these shares and bonds had been pledged as security for one or the other of the Union Pacific's numerous mortgage bond or note issues.

Unable to meet its obligations during the depression which then set in, the company's properties were placed in the hands of receivers in 1893. In the subsequent negotiations between its creditors great difficulty was experienced in arriving at a satisfactory adjustment of the United States government's second lien against the main lines. This difficulty delayed reorganization for several years, and in the meantime the creditors of the branch systems, for their own protection, had proceeded with independent reorganizations of their properties. The great subsidiaries—namely, the Oregon Short Line & Utah Northern, the Oregon Railway & Navigation Company, and the Union Pacific, Denver & Gulf—were each reorganized separately, together taking 4,307 miles of railroad out

of the Union Pacific system. Most of the branch lines were also either reorganized independently or given separate receivers pending reorganization. So that when on January 31, 1898, the new Union Pacific Railroad Company took possession of the properties which had been bought in for it at foreclosure sale, it found itself in possession only of the main lines which its predecessor had owned in fee simple and one or two small branches—in all (June 30, 1898) 1,849.29 miles of railroad.

Thus the Union Pacific had lost 5,832.43 miles of railroad, or by far the larger part of its system. It had also lost its connection with the Pacific ocean. Finally, it was devoid of the branch lines which are the necessary source of traffic of every prosperous railroad system. Thus arose the first great problem which confronted the new management; namely, to bring back into its system on a satisfactory basis all the important branches and feeders which had been cut off during this receivership, and to restore the company's connection with the Pacific. This task was not completed until the latter part of 1900. In fact, one of the former subsidiaries, the St. Joseph & Grand Island, was recaptured only within the last year.

The Union Pacific Railroad Company began its business in February, 1898, with an authorized capital stock of $136,000,000, consisting of $75,000,000 of non-cumulative preferred and $61,000,000 of common stock. It also had an authorized bonded indebtedness of $100,000,000, consisting of 4 per cent. 50-year first mortgage bonds. Its first balance sheet, as of June 30, 1898, was as follows:

Assets.

Cost of railroads, equipment and appurtenances	$221,264,210
Stocks and bonds owned	2,252,962
Trust funds	199,400
Cash	6,071,840
Other current assets	1,526,205
Materials and supplies	961,485
	$232,276,102

Liabilities.

Common stock	$61,000,000
Preferred stock	75,000,000
Funded debt	90,011,000
Interest accrued or unpaid	1,800,275
Vouchers and pay-rolls	1,585,367
Reserve for improvements and equipment	1,082,774
Surplus available for dividends	1,796,686
	$232,276,102

The 1,849 miles of railroad, nearly all main line, with which the company commenced operations, constitute by far the greater portion of the first item among the assets. The valuation (namely, $221,264,210) has no special significance, merely representing approximately the par value of the new shares and bonds which were issued in exchange for the old and for other reorganization purposes. The cash cost of these lines and equipment to the Reorganization Committee has been estimated at about $81,500,000; namely, $40,255,605 paid to the United States government to extinguish its second lien, $13,645,250 paid for the securities in the sinking fund of this second lien, and $27,637,435 bid at the foreclosure sale under the old first mortgage. But these requirements were met by the issuance of mortgage bonds and preferred stock which were not accepted at par. Most of the old high-interest bonds received (in lieu of cash) 100 per cent. of their par value in new 4 per cent. bonds and a bonus of 50 per cent. in new preferred stock. The bankers received corresponding amounts of bonds and preferred stock for the cash which they were called upon to furnish to take up the government lien and for other purposes. Finally, the old shareholders, or their successors, who responded to a cash assessment of $15 a share, were given about $9,000,000 of new preferred stock for this cash, and the $61,000,000 of new common stock for their old shares. "Cost of railroads and equipment" was charged to the extent of the par value of all these securities except the $9,000,000 of preferred stock issued as a result of the cash assessment, and even this was thus charged in so far as a part of the cash was paid out for reorganization expenses as distinguished from being held as working capital. This situation will show the meaning, or rather the lack of meaning, of the cost of properties as stated in a railroad balance sheet.

The Union Pacific's first great step toward regaining its lost mileage was its acquisition early in 1899 of nearly all of the stock of the newly reorganized Oregon Short Line Railroad Company, whose lines connected with its own near Ogden, and extended northwesterly to a junction with those of the Oregon Railroad & Navigation Company. All the securities which had been owned by the old Union Pacific had been pledged by it as security for one or other of its numerous collateral trust bond or note issues. The trustees of these mortgages and indentures had sold portions of this collateral from time to time during the receivership, Kuhn, Loeb & Co., representing the Reorganization Committee, being the principal purchaser. In this way, as early as December, 1897, the committee had obtained possession of $8,460,000 out of the $24,778,600 of capital stock of the reorganized Oregon Short Line Railroad company. This stock was not turned over at once to the new company, but held for its benefit by the syndicate.

In January, 1899, by which time it was seen that the company was going to be strong in earning power (it had already paid one dividend of 1½ per cent. on its preferred stock), the shareholders ratified a proposal to increase its common stock by $27,460,000, and to offer the new shares in exchange for a like amount of Oregon Short Line stock. This offer was accepted by the Short Line shareholders, who paid in cash $3 with each share exchanged. Thus did the Union Pacific take over the stock purchased on its behalf by the Reorganization Committee and enough more to bring the total up to $26,505,300 par value. Since that time all but $10,000 of the remaining Short Line stock has been acquired, so that for all practical purposes the Union Pacific and the Oregon Short Line Companies are one.

In October of the same year the Union Pacific shareholders were called upon to authorize another stock increase, namely, $25,000,000 preferred and $7,718,600 common. The purpose of this was as follows: The old Oregon Short Line & Utah Northern had held, subject to a collateral trust mortgage, $13,827,200 of the $24,000,000 of capital stock of the old Oregon Railway & Navigation Company. In the latter's reorganization this old stock was replaced by an equal amount of common stock of the new Oregon Railroad & Navigation Company, the trustees of the Short Line collateral trust bonds receiving their share. The collateral trust bonds were replaced in the new Oregon Short Line Railroad Company by an equal amount of "Income B and Collateral Trust" bonds. The latter had as security the same Navigation Company shares, together with 24,542 additional shares which were obtained in direct exchange for some of the "Income B" bonds. Thus the Union Pacific, which, as before stated, eventually acquired control of the Short Line, came into virtual possession of these Navigation Company shares.

The Oregon Railroad & Navigation Company was governed at this time by a voting trust representing the Northern Pacific, Great Northern and Union Pacific,* which, as holders of that company's preferred stock, elected two-thirds of the board of directors. By this means it was planned that the Navigation Company should be kept independent of any one system and be made to subserve the interests of all three. Why the arrangement failed to be continued is not understood. But in October, 1899, the Union Pacific offered its $25,000,000 of new preferred stock in exchange for the Navigation Company's preferred stock ($11,000,000 par value), and for the outstanding "Income B" bonds of the Oregon Short Line. These offers were accepted. In fact, it was reported that the Northern Pacific had already sold its holdings of the Navigation Company's stock to the Union Pacific. The purchase of the "Income B" bonds of course gave the Union Pacific a firmer grip upon the $16,281,400 of the Oregon Railroad & Navigation Company's common stock which served as their collateral. The $7,718,600 of new Union Pacific common shares were offered in exchange for an equal quantity (namely, the remainder) of the Navigation Company's common stock. Practically all of the latter's shares of both classes was thus acquired. This restored the Union Pacific's outlet to the Pacific northwest. Henceforth, except for certain legal purposes, the Union Pacific and its two great auxiliaries, the Oregon Short Line and the Oregon Railroad & Navigation Company, may be considered and are virtually one.

In the meantime the Union Pacific had not been idle in the work of regaining its former branch systems. As before stated, all of the old Union Pacific Railway Company's holdings in the shares and bonds of its subsidiaries had been hypothecated under one or more of its collateral trust issues. Much of this collateral, both bonds and shares, was bought in at low prices from time to time by the Harriman syndicate. When the properties of these companies were offered at foreclosure sale, the syndicate bought them in, again at low prices, and turned them over to the Union Pacific. In the latter part of 1898 the company acquired in this way the properties of the Omaha & Republican Valley, the Union Pacific, Lincoln & Colorado, the Kearney & Black Hills, and the Junction City & Fort Kearney. It also purchased, in accordance with the terms of an agreement with the reorganization committee of the Union Pacific, Denver & Gulf, the so-called Julesburg branch of that system. That company itself remained independent. In a similar manner the Union Pacific purchased, in January, 1900, the lines of the Carbon Cut-off Railway and the Echo & Park City Railway. In the latter part of the same year the lines of the Solomon Railroad and the Salina & South-western Railway were acquired. This, with the exception of the recent acquisition of the St. Joseph & Grand Island, completed the Union Pacific's task of regaining the branches of the old system which had been lost to it.

These acquisitions, together with trackage rights over 74.94 miles of other railroad, brought the total mileage operated as of June 30, 1900, by the Union Pacific Railroad Company proper up to 3,033.22 miles. All of these acquisitions were owned in fee simple by the company, and were without any lien encumbrances, having been paid for out of the cash funds in the company's treasury.

*The Great Northern and Northern Pacific had purchased a large quantity of the Navigation Company's stock in Europe. It was stated that the Union Pacific was to acquire an interest in this purchase. Whether it did or not the writer has been unable to ascertain. The financial manuals all represent the Union Pacific as being represented in the voting trust, however.

This statement may seem remarkable. The new company was fortunate from the beginning in several ways. In the first place it had a strong earning power. Its surplus income at the end of the first five months was $1,796,685. In 1899, after the payment of dividends on the preferred stock, which were commenced in September, 1898, the surplus for the year was $2,883,367, and in 1900, after paying dividends on both preferred and common stock, it was $834,183. The surplus earnings of the two auxiliary systems, which by this time were integral parts of the Union Pacific, brought this up to $7,536,737. The Reorganization Committee had started the company with a good cash working capital. In November, 1899, the old Union Pacific Railway Company, which had been kept alive pending the realization on some of its assets and the liquidation of its unsecured liabilities, declared a cash dividend upon those claims. The new Union Pacific, as the holder of some of those obligations which it had bought in at nominal prices, received $5,249,090 in this way. The $3 per share received from the holders of 265,053 shares of Oregon Short Line stock at the time of the exchange described above should not be forgotten.

The Union Pacific's expansion had been financed thus far either by the issuance of stock or out of its cash funds obtained from earnings and other income. The mileage in its system had grown from 1,849.29 miles in 1898 to 5,628.42 miles on June 30, 1901. At the same time the system's management had entered upon a policy of extensive improvements to the railroad and equipment. During the fiscal year 1900-01, according to the report, $8,516,971 was expended for betterment of the lines of the three large companies in the system and $3,571,759 for new equipment. Of the former amount, $4,498,094 represented the cost of making changes in the lines, while the remainder was spent in rectifying grades, widening embankments, laying better ballast, enlarging tunnels, building second and side track, and the like. Of the $12,000,000 used in these two ways in one year, $1,500,000 was appropriated from the surplus earnings of the year. Yet, after deducting this and paying 4 per cent., or approximately $8,000,000 in dividends on the two classes of stock, the formal surplus was still $3,678,175; $2,061,012 represented the appropriation of a "Reserve for Improvement," leaving $8,521,718 to be added to the "Cost of Railways and Equipment." In a similar manner, during the preceding year, $8,977,405 had been expended for betterments and equipment, $2,000,000 of which was charged directly against surplus income, but still leaving the latter at the figure, $7,536,737, given above.

During all this time, as intimated, the Union Pacific had been paying dividends on both its preferred and common stock. Payment of dividends on the preferred stock was commenced in September, 1898, six months after the new company had begun operations, with the distribution of $1.50 per share. The financial operations up to June 30, 1898, were as follows:

Gross earnings, Union Pacific main line	$7,670,579
Miscellaneous income	606,442
Total	$8,277,021
Operating expenses and taxes	4,534,418
Available income	$3,742,603
Fixed charges	1,945,918
Surplus exclusive of branches	$1,796,685

To this surplus was to be added $446,659 as the net results of the operations of the branch lines. Of the total free income of $2,243,344, the preferred dividend took $1,025,000, leaving $1,118,344, or more than 50 per cent., for other purposes. The percentage is respectable enough, but the absolute amount left in the surplus account represented a rather small margin, when we consider that it was the undivided profits of a large railroad system whose financial success was not yet assured.

At the directors' meeting at which the second semi-annual dividend on the preferred stock was declared, a resolution was passed which, in substance, was as follows:

> Whereas the company has been in possession of all of its main lines barely a year, and of its branch lines a less time, and is therefore without a basis of experience for determining any fair average of results for unequal years, and it is not deemed advisable to add to the bonded debt, but to continue a liberal application of surplus income to permanent improvements and additions and to such uses as will secure economy of operation and increased earning power, and thereby establish stable and permanent values for its securities and a reasonably safe minimum basis of regular dividends to its stock, be it
>
> Resolved, That we distribute $1.50 per share on the preferred stock.

The preamble contains a great deal of financial wisdom, especially for a company which had yet to work out its salvation. But it is difficult to see any logical connection between it and the conclusion, unless the directors were trying to justify themselves in paying *only* 1½ per cent. instead of 2 per cent.

In October, 1899, the semi-annual dividend on the preferred stock was increased to its maximum (namely, 2 per cent.), and in February, 1900, the company commenced paying 1½ per cent. semi-annually on the common shares. By this time the surplus earnings were so large that before deducting the appropriations therefrom for betterments and equipment they were more than double the requirements to pay the 3 per cent. per annum to the common shareholders. Accordingly, on July 31, 1900, the semi-annual dividend on this stock was increased to 2 per cent. Yet, in spite of this and in spite of deductions for improvements and equipment, the formal surplus for the year ended June 30, 1901, was $3,678,175. It will readily be appreciated that by this time the Union Pacific was in good financial condition, and possessed of a strong credit wherewith to carry on its activities of the second period of its history.

II.

THE SOUTHERN PACIFIC AND THE NORTHERN SECURITIES COMBINATION.

We may now begin an account of the Union Pacific's activities during this second period. In it the company commenced reaching out and acquiring control of railroad mileage which had not been a part of the former Union Pacific system. The two great events were the purchase of a substantially controlling interest in the stock of the Southern Pacific Company and the fight with the Hill-Morgan interests for control of Northern Pacific. It is true that Mr. Harriman and his associates had about completed their now famous Chicago & Alton deal; but, although this promoted friendly relations between the Alton and the Union Pacific, there was no formal connection between the two until a much more recent date.

In January, 1901, Kuhn, Loeb & Co., acting on behalf of the Union Pacific, purchased $75,000,000 par value of the Southern Pacific Company's stock. The total outstanding share capital of this company was $197,832,148. This purchase did not, therefore, give absolute control of that company; it represented a substantial control, however. A year later another $15,000,000 of the stock was acquired. The major portion of the original purchase was obtained by the Harriman Syndicate from Speyer & Co., of New York city. It consisted of the so-called Speyer and Huntington interests. The former was estimated by current financial writers at about $20,000,000 par value. It was accumulated a year earlier from the estates of Charles Croker and Leland Stanford, two of C. P. Huntington's former associates. The original Huntington interest consisted of 600,000 out of the 2,000,000 shares of the Southern Pacific Company. Of these 400,000 shares were left to the widow of C. P. Huntington, and 200,000 to his nephew, H. E. Huntington. Of the total Huntington interest, that portion held by Speyer & Co. at the time of this purchase was variously estimated at from 300,000 to 430,000 shares. These two blocks of stock would not account, therefore, for the entire 750,000 shares included in the purchase.

Opinion was expressed at the time to the effect that a considerable portion of this stock must have been acquired in the open market. Certain it is that Southern Pacific stock was very active just a few days previous to the announcement of the purchase. On January 29, 1901, 187,760 shares changed hands at prices ranging from $45.50 to $47 per share. During the next two days the total sales amounted to 326,000 shares at prices ranging from $46.62½ to $48.25 per share. In two days more shares changed hands than were traded in during a week before this time, and the company's stock had been one of the most active of the entire list during a period of at least two months previous to the consummation of this purchase. This does not mean that Kuhn, Loeb & Co. bought all of these extra shares. But to obtain at a fair price what was finally taken probably required a great deal of stock market manipulation on the part of their generals, involving the sale and repurchase of a large additional number of shares.*

An important question is, How was this purchase financed? Within a few days after the purchases had been consummated (they were announced on February 1, 1901), the Union Pacific advertised a new bond issue of $100,000,000. These bonds bore 4 per cent. interest, matured at the end of 10 years, and were convertible, dollar for dollar, into common stock of the company at any time before May 1, 1906. To provide for this conversion, the authorized common stock was also increased $100,000,000, but, of course, the new stock was not issued except as the new bonds were presented for conversion. The security of these bonds consisted of a first lien upon about 859 miles of the branch lines which had been acquired as described above, and the following railroad stocks and bonds:

Southern Pacific Co. capital stock	$75,000,000
Oregon Shore Line, capital stock	27,334,700
Oregon R. R. & Navigation Co. common stock	7,633,500
Oregon R.R. & Navigation Co. preferred stock	9,876,200
Union Pacific Coal Co., 1st mortgage bonds	4,706,000
Leavenworth, Kansas & Western Ry., capital stock	1,000,000

The Short Line and Navigation Companies' stocks had been acquired by the Union Pacific in exchange for its own shares, as described above, and were, therefore, "free assets." All this collateral was pledged at a valuation of $87,080,400, the Southern Pacific stock having been placed at 50 per cent. of par, a little more than its market value at the time. The railroad lines were valued at $20,485,400. Altogether, security of an estimated value of $107,565,800 was pledged under this $100,000,000 bond issue. The pro-

*The financial paragraphs of that time state that the large transactions in this stock indicated a "liberal application of Wall Street laundry methods." *i. e.*, "wash," or bogus sales. Whether this manipulation was connected with Kuhn, Loeb & Co.'s purchase of the stock or was independent cannot, of course, be known. It can only be inferred.

ceeds of the bond sales were to be "used for lawful corporate purposes."

It is noteworthy that little more than 33⅓ per cent. of the value of the above security consisted of the Southern Pacific stock purchased. There are two partial explanations of this. In the first place, that stock was not paying dividends, so that the bonds would have no income behind them in case the Union Pacific should tire of the interest burden. Further, it did not represent absolute control of the Southern Pacific Company, so that the bondholders could not force dividend payments even if they seized the collateral. Additional security would be needed, therefore, to render the bonds marketable on favorable terms. In the second place only $40,000,000 of these bonds were to be used to finance the Southern Pacific purchase, the other $60,000,000 being reserved for other "lawful corporate purposes." The entire bond issue was eventually subscribed by the shareholders, the subscription being underwritten by Kuhn, Loeb & Co.

The importance of this deal will readily be appreciated. It gave the Union Pacific substantial control over 9,500 miles of railroad, stretching from New Orleans to San Francisco, from San Francisco to Ogden, Utah, and gridironing the states of Texas and California. On 7,545 miles of this total the gross earnings in 1900 were $64,400,000. On only one railroad system (namely, that of the Pennsylvania Railroad Company) did the gross earnings then exceed this figure. The feeling current in financial circles of that day was that the control would result in less friction between the Union Pacific and Southern Pacific systems. The Union Pacific management, however, were careful to give out that their purpose was to insure "harmonious relations" in the interchange of traffic between their system and the Central Pacific, which, joining with the former near Ogden, connected it with San Francisco, but whose stock was owned by the Southern Pacific Company. The Union Pacific and Central Pacific had been conceived and built as one continuous line from the Missouri river to the Golden Gate, and should logically have been owned by one company. Under the separate companies, however, their relationships had at times been anything but harmonious. The Southern Pacific purchase did away with this friction. It also conferred another important benefit upon the Union Pacific; namely, steamship connection with the Orient through the Pacific Mail Steamship Company, control of which had recently been acquired by the Southern Pacific Company.

Of Southern Pacific finances we have little to do in this story. We may, therefore, seize this opportunity for disposing of them. The Union Pacific inaugurated, or, rather, continued, a very extensive betterment policy for its southern auxiliary, causing it to use all of its surplus income for a number of years thereafter for improvements and the purchase of equipment. In an analysis of that system's accounts made by White & Kemble in 1902 it was estimated that in addition to past expenditures another $40,000,000 would be needed to completely modernize the property. During the four years from 1902 to 1905, inclusive, the Southern Pacific Company expended from its earnings, in improving and better equipping its properties, the enormous sum of $33,409,611, an average of $8,352,403 a year. For the fiscal year ended June 30, 1906, after providing for dividends on its stock, the company's stated surplus was $11,118,838. Of this it acknowledges the expenditure of $6,381,775 for betterment and equipment purposes. There was a further $2,354,218 appropriated for betterments, which was charged directly to the operating expenses of the year, bringing the total appropriation and expenditure for betterments and equipment up to $8,735,993.

During these six years not only has the Southern Pacific Company appropriated its stated surplus income for these betterment purposes, but it has apparently improved its existing equipment at the expense of its operating account. This is indicated by the following facts. The average stated cost per mile run of maintaining locomotives during this period has been 9.17 cents; that of the Union Pacific was 9.82 cents. But the similar expenditures on a number of other systems somewhat similarly situated range between 6 and 7 cents per mile run. This may be interpreted in part as meaning that both the Union Pacific and Southern Pacific are pursuing the very liberal practice of sending old locomotives to the scrap heap, replacing them with more modern and expensive locomotives, and charging the entire cost of the latter to operating expenses. Again, the average stated cost per mile run of maintaining passenger cars on the Southern Pacific line has been 1.028 cents, which is well above the average of 9.1 mills on other systems. Finally, the cost of maintaining freight cars has averaged 6.99 mills per mile run as compared with a maximum of 6 mills on about 12 other systems. We may infer, then, that the Southern Pacific Company has been improving the character of its equipment, charging the difference in cost between the old and the new directly to "operating expenses" instead of to "cost of railroads and equipment." What an opportunity some financier of the future will have for capitalizing these expenditures, issuing bonds to represent them, and from the proceeds of the sale thereof declaring a 30 per cent. dividend!

Not only has the Southern Pacific Company bettered its system by the use of funds obtained in this way, but it has made extensive capital expenditures from funds obtained from the outside as well. During the years 1903 and 1904 it borrowed from the treasury of the Union Pacific system a total sum of $20,460,927. But finally, in the latter part of 1904, it was decided by the Harriman management to capitalize some of these expenditures and to obtain funds from the outside with which to continue these betterment activities. Accordingly, the stockholders voted to create an issue of 7 per cent. non-cumulative preferred stock amounting to $100,000,000. Of this $40,000,000 was offered to the old shareholders for pro rata subscription at par. A part of the proceeds was used to reimburse the Union Pacific treasury. The Oregon Short Line took $18,000,000 of the new stock.

Under the policy inaugurated by the Harriman management the Southern Pacific system's net earnings increased from $22,500,000 to $37,500,000. Owing to the liberal maintenance policy, however, the operating ratio (*i.e.*, the ratio of operating expenses to gross earnings) has not decreased, but, on the contrary, has increased somewhat. The operating ratio is taken as an indication of the economy of management, but the high ratio of the past should be followed by a lower ratio in the future if the betterment expenditures realize their purpose. The following table will show to best advantage the growth of the system's traffic and earnings:

Southern Pacific System.

	1901.	1902.	1903.	1904.	1905.	1906.
Density of passenger traffic	108,047	124,110	124,996	140,696	141,661	152,032
Density of freight traffic	561,838	566,099	569,487	591,450	600,743	678,513
Gross earnings per mile	$8,503	$9,012	$9,371	$9,631	$9,784	$10,783
Operating expenses, per mile	5,324	5,824	6,305	6,459	6,406	6,827
Operating ratio, per cent	62.6	64.6	67.3	67.1	65.5	63.3
Net earnings per mile	$3,179	$3,188	$3,066	$3,172	$3,378	$3,956
Fixed charges per mile	2,390	2,322	2,264	2,444	2,269	2,208

By "density of passenger traffic" is meant, in technical language, the average number of passengers carried one mile per mile of road operated. Thus the figure for 1901 indicates that for each mile of road operated the company did the work equivalent to carrying 108,047 passengers one mile. A similar definition applies to the term "density of freight traffic." The enormous growth of the Southern Pacific traffic is indicated by the increase in these averages year by year. The gross earnings and operating expenses per mile have also increased, the one correspondingly, the other more than correspondingly. The management's liberal maintenance policy is indicated in the high operating ratios of 1902, 1903 and 1904. Since the last date this ratio has rapidly fallen off, possibly showing that the liberal maintenance and betterment policies have begun to have their desired effect of increasing the economy of operation. The result has been a rapid growth in the average net earnings per mile since 1903. The declaration in October, 1906, of dividends on the Southern Pacific Company's common stock will be discussed in its proper connection in the story of Union Pacific finances which will now be resumed.

The other great event of the year 1901 was the contest between the Harriman Syndicate, representing Union Pacific interests on the one side and the Hill-Morgan interests on the other, over the control of the Northern Pacific Railway. It is evident that the Great Northern and Northern Pacific wished to secure a permanent connection of the terminus of their lines at St. Paul with Chicago. Early in 1901 there arose persistent rumors that these two companies were negotiating for a lease of the line of the Chicago, Milwaukee & St. Paul. These rumors were officially denied. Yet one individual, said to be high in Great Northern councils, gave out that they were founded in fact, and that the only point to be settled was the amount of the dividend to be guaranteed on St. Paul stock. Nevertheless, the deal was never consummated. At the same time Dame Rumor had it that the Union Pacific was trying to obtain control of the Chicago, Burlington & Quincy. This, if acquired, would give the Union Pacific direct access to Chicago. It would also drain a large volume of westbound traffic through the Union Pacific outlet.

There seems to have been a substantial foundation in truth for these rumors. As explained afterwards by President James J. Hill, of the Great Northern, the success of the Union Pacific in this attempt would have shut the Great Northern and Northern Pacific out of most of the territories of Nebraska, Kansas, Missouri, South Dakota, Iowa, Illinois and Wisconsin. To prevent this, the two companies entered into negotiations with the directors of the Burlington, making proposals for the purchase of their entire property. These were successful, practically the entire $109,324,000 of the stock of the Chicago, Burlington & Quincy Railroad Company being purchased by the two companies at $200 per hundred-dollar share. The Union Pacific asked to be admitted as a participant in this purchase, but the Morgan-Hill interests refused to accede to the request, because to do so would have defeated the purpose of their move.

Mr. Harriman decided to fight. Under the terms of the purchase, the Northern Pacific was to have a half interest in the control of the Burlington. If the Union Pacific could gain control of Northern Pacific, all would yet be well with its own interests. Accordingly, his bankers purchased over $60,000,000 of Northern Pacific stock in Europe and the United States. Mr. Hill and his friends

found that they held about $26,000,000 of the common stock of that company. Mr. Morgan succeeded in obtaining in London and New York about $16,000,000 more. The bidding of the rival factions, together with that of the speculators who found themselves "short" of the stock, forced the price up to $1,000 a share, and precipitated the stock market panic of May 9, 1901. The result was that, after the contending parties had taken account of their holdings, the Morgan-Hill interests owned $42,000,000 out of the $80,000,000 of Northern Pacific common stock and probably $34,000,000 of the preferred stock, while the Harriman Syndicate held $37,000,000 of the one and $41,000,000 of the other.

The Union Pacific people claimed absolute control of the Northern Pacific Railway Company and through it a one-half interest in the control of the Burlington. In his stock purchases, however, Mr. Harriman overlooked one vital fact. According to the charter of the Northern Pacific Railway Company its common stockholders had the right to call in all the preferred stock for redemption in cash at par. This move was decided upon by Mr. Hill and his friends. To finance this redemption, the Northern Pacific offered its common shareholders for pro rata subscription at par $75,000,000 of 4 per cent. debentures, which were convertible, dollar for dollar, into common stock. The Harriman Syndicate received its share of these debentures, about $34,700,000, and of course would convert them into common stock. This would necessitate a similar conversion of their debentures by the Morgan-Hill faction if they were to retain their control. In the end, however, the Union Pacific party would hold only about $61,700,000 out of the new $155,000,000 of stock of the Northern Pacific.

Control of Northern Pacific was lost to Mr. Harriman and his associates, but he would still hold enough stock to make him dangerous. Consequently, a compromise was effected. This involved in the first place the formation of the Northern Securities Company to acquire as much as possible of the share capital of the Great Northern and Northern Pacific, Mr. Harriman agreeing to exchange his holdings in the latter for stock of the new company; secondly, the formation of a new Chicago, Burlington & Quincy *Railway* Company to take a 99-year lease of the existing Chicago, Burlington & Quincy *Railroad* Company's lines. The Union Pacific interests were to share with the two northern companies in the management of this new corporation, thereby being assured good treatment. At the same time the new company guaranteed the payment of 7 per cent. dividends on the old Burlington's stock, most of which had been pledged as security for the Great Northern and Northern Pacific C., B. & Q. collateral joint 4 per cent. bonds. One object of the formation of the Northern Securities Company was probably to enable the Morgan-Hill faction to resell a part of their stock without losing control of the Northern Pacific; for after the exchange the Union Pacific would hold only $82,491,000 out of over $394,000,000 of Northern Securities stock, or about 23 per cent. This would leave a wide margin for sale by the other faction.

We have finally to inquire how the Union Pacific financed these extensive stock purchases and subscriptions. The prices paid for Northern Pacific preferred and common shares are not known, but Mr. Mahl, controller of the Union Pacific system, testified at the recent investigation that the Northern Securities stock cost $79,459,691.36. Presumably, this was the sum paid for the original 781,080 shares of Northern Pacific stock which were exchanged. This is assumed to be true. Sixty millions of this were provided out of the proceeds of the sale of the convertible bond issue mentioned above in connection with the Southern Pacific purchase. The remaining funds were evidently borrowed from the banks, as is evidenced by the fact that the Union Pacific system's net floating debt on June 30, 1901, was $30,249,459 larger than it was a year before, and that for several years thereafter the company had outstanding large amounts ($28,750,000 in 1902) of "Loans and Bills Payable."

Later the Union Pacific received $41,085,000 in cash for that amount of Northern Pacific preferred shares which it held. Out of this it paid about $34,700,000 for its subscription to that company's convertible debentures, leaving about $6,300,000 of cash in the treasury. But, of course, this was not available for the financial purposes with which we are dealing. This is important, however, in that it left the net cost of the $82,491,000 of Northern Securities stock which the company eventually received at about $73,160,000, freeing the remaining $6,300,000 of the original investment for other corporate purposes.

The title to the Northern Pacific shares, and later to the Northern Securities shares received in exchange, was vested in the Oregon Short Line Railroad Company. That company issued to the Union Pacific Railroad Company in payment therefor its purchase money certificates of indebtedness amounting to $61,000,000. This transaction was merely between these two companies, and had nothing to do with the work of financing the purchase of the stock. It was probably a method of technically avoiding the laws against the combination of parallel railroad lines.

During the year 1901-02 the Union Pacific advanced $4,393,887 to future subsidiaries to aid them in constructing their lines. In June and July, 1902, it purchased an additional $15,000,000 par value of the Southern Pacific Company's stock, bringing its total holdings up to $90,000,000. These shares cost about $7,500,000. During 1903 and 1904, as we have seen, it advanced an aggregate of $20,460,927 to that company to aid it in carrying out its betterment policy. The Union Pacific also advanced to the Pacific Mail Steamship Company during the two years the sum of $5,055,311. This was to aid that company in the construction of two large steamers for the trade with the Orient.

These activities in 1903 were financed partly out of cash funds already in the treasury, partly out of current earnings, but mainly by the issuance of $36,000,000 of Oregon Short Line 4 per cent. and participating (collateral trust) bonds. That company pledged all of the $82,491,000 par value of Northern Securities stock, which it received under the terms of the compromise with the Morgan-Hill interests, as security for an equal amount of these "Participating Fours." The latter it was caused to give to the Union Pacific Railroad Company at 10 per cent. discount to take up the $61,000,000 of purchase money certificates mentioned above and for other debts which it owed to the parent organization. Thirty-one millions of these bonds were at once offered to the Union Pacific shareholders for pro rata subscription at 90 and interest, and another five millions were sold later. The proceeds were used partly for the purposes mentioned above and partly to pay off $14,500,000 of the loans contracted at the time of the Northern Pacific purchase. Thus was this purchase eventually financed in part by means of the Oregon Short Line "Participating Fours." The remainder of these bonds was never sold to the public.

In 1904 the Union Pacific embarked upon a new enterprise. This was the purchase of a one-half interest in the San Pedro, Los Angeles & Salt Lake Railway Company. This company was originated by Senator Clark, of Montana, to build a line of railroad from San Pedro on the California coast, near Los Angeles, through that city northeasterly through southern Nevada and western central Utah to Salt Lake City. Its construction and acquisition would give the Union Pacific a direct line to the fruit-growing section of southern California. In 1904 the Oregon Short Line purchased from Senator Clark a one-half interest in this line, paying therefor and for its share of advances to it for construction purposes up to June 30, 1904, the sum of $14,960,000. During the next year additional payments of $5,440,000 were made. At the same time the Oregon Short Line sold to its newly acquired subsidiary about 340 miles of its own line which stood on its books at a valuation of $7,043,994. The acquisition by the San Pedro of these lines, which extend from Salt Lake City southerly to Calientes, Nevada, relieved it from the necessity of building so much railroad. A portion of the funds required for these and the other advances of the year was obtained by the sale of $10,000,000 of Union Pacific collateral trust notes.

On March 14, 1904, the United States Supreme Court handed down a decision, affirming that of the lower court, to the effect that the Northern Securities Company was a combination in restraint of trade and illegal. It enjoined that company from collecting dividends on the Great Northern and Northern Pacific stock, and entailed the redistribution of this stock to its shareholders. This resulted in other financial measures on the part of the Union Pacific and Oregon Short Line. But another matter must be discussed before that tale is related.

It will be recalled that in 1901 the Union Pacific shareholders subscribed to a huge bond issue aggregating one hundred millions of dollars. The purpose of this issue, as before stated, was to finance the Southern Pacific purchase and to finance in part the acquisition of Northern Pacific stock. These bonds bore 4 per cent. interest, and were convertible at any time before May 1, 1906, into common stock at par. This common stock was paying at that time only 4 per cent. dividends, so that for the time being the conversion clause was not very attractive. Only $12,743,000 of the bonds were converted up to June 30, 1904. But during this time the Union Pacific's net earnings increased very rapidly, so that, despite large appropriations therefrom every year for betterments and equipment and despite the increases in dividends, large sums were left to be carried to the formal surplus account. It became evident that Union Pacific common stock was a good investment and was going to improve, especially since it possessed the entire equity in the net income after 4 per cent. had been distributed to the preferred shareholders. During the fiscal year ended June 30, 1905, there was converted a total of $56,071,000 of these bonds, and after the increase of the common stock dividend to a 5 per cent. basis in October, 1905, and to a 6 per cent. basis in April, 1906, another $32,687,000 of these bonds was exchanged. In August, 1906, only $500,000 of the original hundred millions were outstanding, and these were called for redemption.

According to the terms of the trust agreement securing these bonds, as they were converted, a proportionate amount of their underlying collateral could be released. In this way during the years 1901 to 1904, inclusive, the Union Pacific came into free possession of a considerable amount of Oregon Railroad & Navigation Company and other stock which had originally been pledged under

this mortgage. These shares could be used, if desirable, as collateral for other loans.

Again, as stated above, in 1904 the Southern Pacific Company was caused to create an issue of $100,000,000 of 7 per cent. non-cumulative preferred stock, 40 millions of which was offered to its old shareholders at par. The Oregon Short Line, as the holder of $90,000,000 of its old stock, took $18,000,000 of these new preferred shares. Out of the proceeds of this stock sale, also, the Union Pacific system's treasuries were repaid the $20,460,960 which had previously been loaned to the Southern Pacific Company. As a net result, the Union Pacific system, after paying its subscription, gained $2,460,960 in cash and $18,000,000 par value in securities.

Considerable importance must be attached to the above-described activities. The possession of this Southern Pacific preferred stock as a free asset, and the freeing of the Navigation Company's common and preferred stock, gave the Union Pacific system securities which it could use as collateral for further loans, or could substitute for and thereby release securities which might be more valuable for certain purposes. The significance of this will be seen presently.

Let us return now to the main thread of our story. The method decided upon by the Northern Securities Company of distributing to its shareholders the Northern Pacific and Great Northern stock in its treasury was to give $30.17 par value of Great Northern and $39.27 of Northern Pacific* stock and $1 in Northern Securities "Stubs" for each hundred-dollar share of its own stock surrendered. If carried out, this would give the Oregon Short Line in exchange for its 824,910 shares of Northern Securities stock the following amounts of securities: Great Northern shares, $24,887,534.70; Northern Pacific shares, $32,394,215.70; Northern Securities stubs, $824,910.† These securities would come in time into the hands of the trustees of the Oregon Short Line "Participating Fours."

And thereby hangs a tale. Pending this distribution the Northern Securities Company could not collect the dividends declared upon the Great Northern and Northern Pacific stock. That being true, it could not pay dividends on its own shares. Since this was true, again, there was no income accruing to the Oregon Short Line upon the collateral, consisting, it will be remembered, of Northern Securities stock, underlying its "Participating Fours." Hence that company had to pay the 4 per cent. interest drawn by those bonds with funds derived from other sources. Those uncollectible dividends, however, were accumulating in the Northern Pacific and Great Northern treasuries and, after the completion of the above stock distribution, its share of them would be received by the Oregon Short Line. Now an important privilege accruing to the holders of the "Participating Fours" was that of sharing each year in the income received upon their collateral to the extent that this income exceeded during that year the 4 per cent. interest drawn by their bonds. There was grave danger that, when these back dividends were finally received, the holders of the bonds would insist upon being given the entire amount, notwithstanding the fact that in reality a part of them was to be set over against the interest already paid on those bonds during the legal deadlock. To avoid this, it was decided to call in these "Participating Fours" for redemption at 102½, as was permitted under the terms of the trust indenture securing those bonds.

To retire these bonds and for "other corporate purposes," the Oregon Short Line created an issue of "Four Per Cent. Refunding Twenty-five Year Gold Bonds" amounting to $100,000,000. A portion of this new issue, amounting to $42,250,000, was sold at 96 and interest, or given to the holders of the "Participating Fours" for the principal and accrued interest of their bonds at a corresponding rate. The remaining $57,750,000 was retained in the treasury of the Union Pacific Railroad Company.

According to the advertisement, the security of this new issue was to have consisted of whatever the company received in exchange for its Northern Securities holdings and of any other shares or bonds at not exceeding 80 per cent. of their appraised value. For months all holders of these bonds imagined that their security consisted of Northern Pacific and Great Northern stock and Northern Securities stubs, as described in a foregoing paragraph. When the mortgage finally appeared,‡ the investors were much surprised to find that the actual collateral consisted of the following:

Northern Securities stubs	$5,000,000
Southern Pacific Company preferred stock	18,000,000
Southern Pacific Company common stock	90,000,000
Oregon R. R. & Navigation Co. preferred stock	10,000,000
Oregon R. R. & Navigation Co. common stock	20,000,000

No Northern Pacific or Great Northern stock was included.

The significance of the Union Pacific's bond conversions described above will now be seen. By the time the Oregon Short Line's new refunding mortgage was given out, which was late in 1905, enough of the former company's bonds had been converted into stock to release not only the underlying shares of the Navigation Company, but those of the Southern Pacific Company as well. These securities were substituted under the new mortgage, thereby freeing the Northern Pacific and Great Northern stock for other purposes of the system. What was done with these securities we shall now see.

III.

INVESTMENTS IN OTHER RAILROADS.

We reach now the third and most recent stage in the expansion of the system or in the expansion of its interests—the investments made within the last year or two in sundry other railroads not closely connected with the system itself. These investments are closely connected with the financial operations arising out of the Northern Securities combination.

It might be maintained that the funds with which the Union Pacific Railroad Company and its auxiliary have carried on their vast operations of the past few months were those obtained by means of the bond issue of 1901, but which the subsequent conversion of those bonds freed for the general uses of the company. The fact that they were embodied for a time in Great Northern and Northern Pacific stock was merely an incident; an incident, however, which had important results.

The Oregon Short Line made the following disposition of its original Northern Securities stock.† Of the $82,491,871 of these shares originally acquired, $10,000,000 was sold for $16,880,019 cash, $72,491,871 was exchanged for $21,652,089 par value of Great Northern stock, $28,182,882 of Northern Pacific stock, and $724,919 of Northern Securities stubs. These shares might have been held as an investment. The 7 per cent. dividend paid by each of the two railroad companies would yield about $3,488,448 annually. The market prices of these two stocks became very high, however. The average market price of Northern Pacific stock during 1905 was about $199 a share; for January and February, 1906, during which time over one million shares changed hands, it was about $216 a share; for the first six months of 1906 it was about $205. The average price of the Great Northern stock during 1905 was about $290 a share; during the first half of 1906 it was about $306, and the quotations were as high as $348 per share at one time. At these prices the Union Pacific holdings in these two stocks together were yielding in dividends less 3 per cent. of their market value. There were other good railroad stocks which could be obtained at prices which would yield a much larger income. Manifestly, it would be merely a plain business proposition, if there were no other reason, to sell the Great Northern and Northern Pacific shares and reinvest the proceeds in other securities. This was done.

Other motives no doubt entered. The Great Northern and Northern Pacific lines paralleled those of the Union Pacific system, and to retain their shares might entail other legal complications. Then there were the old dreams of a continuous transcontinental railroad line from the Atlantic coast to the Pacific.

According to Mr. Mahl's testimony, of the original $28,182,882 of Northern Pacific stock acquired in the exchange, $24,030,082 par value was sold for $50,166,357.95, an average of $208.76 per share; $4,152,800 had been unsold at the date of the investigation (February, 1907). Of Great Northern stock, $21,652,089 par value was obtained in the exchange for Northern Securities stock, and $3,744,400 was acquired subsequently through a subscription to new stock at par. Of this, $16,360,089 par value was sold for $49,801,576.47, an average of $304.41 per share; $9,036,400 remained unsold at the date of the investigation. The Union Pacific also received on account of its holdings in Great Northern stock 90,364 shares of that company's ore certificates, which were quoted at from $70 to $85 per share.

From these sales, it will be seen, the Union Pacific realized in cash about $116,848,000. At the same time it retained securities which, at the same prices, were of the aggregate value in round numbers of about $43,000,000. According to Mr. Mahl's statement, the original Northern Securities stock cost $79,459,691.36. Presumably, this was the cost of the 781,080 shares of Northern Pacific preferred and common stock which were purchased in the first instance. As shown above, in the subsequent redemption of the preferred shares about $6,300,000 of this investment came back to the Oregon Short Line in cash. This would reduce the final cost of Northern Securities stock to about $73,159,700. Add to this the $3,744,400 of cash subsequently paid on the subscription for that amount of new Great Northern stock, and the total investment in these securities was about $76,904,100. To represent this the Union Pacific holds in securities or has realized in cash, as shown at the

*A return of 1 per cent. of the Northern Securities stock surrendered because of other of the company's assets not realized upon.

†Mr. Harriman asked that he be returned the original 781,080 shares of Northern Pacific stock which he had turned over to the Northern Securities Company on the ground that, the combination being illegal, the recipt by that company of those shares was illegal, a good title to them could not pass, and, therefore, that the title to them remained in the Oregon Short Line Railroad Co. This would have given the Oregon Short Line the control of the Northern Pacific Railway Company. But his position was not sustained by the courts.

‡The Union Pacific has a peculiar faculty for issuing and selling bonds and not exhibiting the mortgage instrument until weeks or even months afterward.

†William Mahl, controller of the Union Pacific System, at the Interstate Commerce Commission's recent investigation.

beginning of the paragraph, about $159,848,000. This represents a profit in hand and on paper of about $82,943,900, or 113 per cent.

Some wonderment has been expressed concerning the source of the funds with which the Union Pacific made its vast stock purchases of the past few months. It has been stated that this company is the most potent factor in the investment market. The above account will show the source of at least the major portion of these funds. But what has been done with them?

It was reported that in September, 1904, Kuhn, Loeb & Co. had purchased several hundred thousand shares (variously estimated at from 300,000 to 480,000) of the capital stock of the Atchison, Topeka & Santa Fé Railway Company for the purpose of obtaining for the "Union Pacific interests" a minority holding sufficient to maintain "harmonious relations" between the two systems. Later President Ripley, of the Atchison, stated that Messrs. John D. Rockefeller and James Stillman had acquired $25,000,000 of his company's stock. These shares must have been held privately, however, since the Union Pacific's report as of June 30, 1905, which contains a detailed table of all securities owned by the company, shows that no Atchison stock was included in its holdings.

During that fiscal year, however, the Union Pacific acquired $10,343,100 out of the $19,544,000 of preferred stock of the Chicago & Alton Railway Company. In December, 1903, Kuhn, Loeb & Co. issued a circular asking for the deposit, with certain designated trustees, of the Chicago & Alton preferred stock for the purpose of selling it for cash or for the notes of any one or more dividend-paying railroad companies. If notes were taken, they were to bear not less than 5 per cent. interest per annum, mature in not more than five years, and be secured by this preferred stock itself. Large deposits under this agreement were reported. On October 1, 1904, Kuhn, Loeb & Co. announced the sale of this stock at $84 per share. The purchaser was not mentioned, but presumably it was the Union Pacific, since E. H. Harriman and two of his associates in Alton finances constituted the administrative committee under the agreement. In that case the Chicago & Alton shares cost the Union Pacific about $8,688,204. During the same year the Rock Island had also acquired $18,790,000 of Alton stock, and the two companies entered into an agreement for joint alternating control of this property.*

The Union Pacific's table of stocks and bonds owned (contained in its report as of June 30, 1906) does not show extensive investments up to that time in the share capital of independent railroad corporations. The company is shown to own still $15,436,400 par value of Great Northern stock and $13,352,800 of Northern Pacific. The Alton shares represented the only additional purchases up to that time. Yet there had been extensive sales of the former two stocks, enough to decrease the book value of the company's "Stocks and Bonds Owned" to the extent of $62,493,520. This is an enormous sum to lie idle, but it was not all idle. To represent the proceeds, the company had increased its cash on hand $13,913,318, bringing the total up to $21,258,883, its advances to other companies for construction purposes by $16,841,646, and held "Demand Loans" to the extent of $34,710,000, besides other smaller items. The last item is remarkable. As we have seen, during two former years the Union Pacific had lent the Southern Pacific Company over $20,000,000; but these were not carried as demand loans. The reader will wonder who the borrowers of this enormous amount of funds were. Were they other companies, officers of the Union Pacific, or were these funds put out on call loans in Wall street? He will be left wondering, for the company's report throws no light upon the subject.

After June 30, 1906, the Union Pacific made up for the time it had lost in the work of reinvesting its funds. According to the testimony of Mr. Mahl, the company purchased, between that date and the Interstate Commerce Commission's investigation, a mass of securities of an aggregate cost of $131,970,018.46. Summarized these consist of the following:

Acquired by the Union Pacific Railroad Company.

	Par value.	Cost.	Cost, per share.
Illinois Central R.R. Co.	$18,623,100	$32,618,883.53	$175.15
Railroad Securities Co.:			
Common stock	3,415,400	6,905,156.42	202.18
Preferred stock	1,898,400	1,917,988.42	101.03
St. Joseph & Grand Island:			
First preferred	932,000		
Second preferred	1,250,000	2,022,540.00	39.79
Common	2,900,000		
Fresno City Railway	495,650	106,410.98	21.47
Pacific Fruit Express*	1,200,000	1,200,000.00	100.00
Total	$30,712,550	$44,770,979.35	$145.77

*10 per cent. subscription to $12,000,000.

Acquired by the Oregon Short Line Railroad Company.

	Par value.	Cost.	Cost, per share.
Atch., Topeka & S. Fe preferred stock.	$10,000,000	$10,395,000.00	$103.95
Baltimore & Ohio: Common	32,334,200	38,801,040.00	120.00
Preferred stock	7,206,400	6,665,920.00	92.50
C., M. & St. Paul Ry. common	3,690,000	6,274,500.24	170.04
Chicago & Northwestern common	2,572,000	5,303,673.94	204.21
New York Central	14,285,745	19,634,324.93	137.44
Northern Pacific Ry.†	124,580	124,580.00	100.00
Total	$70,212,925	$87,199,039.11	$124.19
Total, both companies	100,925,475	131,970,018.46	130.76

†5 per cent. subscription to $2,491,600.

In computing the average cost, a par value of $100 a share is assumed in every case. Of the total, $45,466,960 was the cost of Baltimore & Ohio stock. Of this, it was stated by Mr. Harriman in the investigation, $36,393,432 was unpaid as yet, leaving $94,576,586 to represent the reinvestment of the proceeds of the sales of Great Northern and Northern Pacific stock. To this is to be added, possibly, the $8,688,204 paid for the Chicago & Alton shares in 1904. We have accounted in this way for $103,264,790 out of the $116,848,000 estimated above as constituting those proceeds. The Union Pacific's advances to other companies will account for the remainder.

At present rates of dividend, the annual income on all of these shares aggregates $4,693,703, which is nearly 4.55 per cent. on their cost. This is to be compared with the barely 3 per cent. which the Great Northern and Northern Pacific stocks yielded on their market value at the time of their sale. This annual income itself exceeds the total income received in dividends on those two stocks by $1,205,255. There is yet to be counted the income on the unsold Great Northern and Northern Pacific stock which would bring this excess up to $2,128,500. As before stated, the Union Pacific's sales and reinvestments were a good stroke of business.

Concerning the purchase of the Illinois Central's stock Mr. Harriman stated on the stand that control of this system was not one of the Union Pacific's motives, since control had not been acquired. This illustrates Mr. Harriman's acuteness in taking advantage of a technicality. Technically, the Union Pacific does not have control of the Illinois Central, since it owns only $18,623,100 out of the total amount issued of that company's stock—namely, $95,042,600; control of the Railroad Securities Company gives it voting power over possibly another ten millions owned by that company. But these holdings certainly give the Union Pacific a strong influence in the direction of the Illinois Central's affairs, and constitute a large nucleus about which to build up actual control of that company.

Further, Mr. Harriman's own words, as recorded in the minutes of the Union Pacific's board of directors, show that he did contemplate control of the Illinois Central when he advised the purchase of its stock. Summarized, Mr. Harriman's argument for the purchase was as follows: (1) The Union Pacific served a large grain-producing country, but had no line to the Gulf or to Chicago and the southeast; (2) the value of a system having low grades and extending from the territory north of the Missouri river to the Gulf will be enhanced by the Panama Canal: the importance of such a connection to the Union Pacific is very great; (3) the strategic value of the Illinois Central is little understood and appreciated, and its stock is bound to become much more valuable.

In the last argument Mr. Harriman might be interpreted as advising the purchase of the Illinois Central's stock for investment or speculative purposes. But there is certainly running through the entire argument the idea that the control of the Illinois Central would greatly benefit the Union Pacific on account of the latter's grain traffic. One proposition in which far-seeing railroad managers are coming to believe thoroughly is that eventually the foreign-bound grain from the Mississippi basin, and especially from the states west of that river, will move by way of the Gulf instead of the Atlantic ports. Because of this idea certain systems, notably the Rock Island and the Missouri Pacific, have been throwing lines into the Gulf ports. When this time comes, the Illinois Central will probably be the most strategically located railroad system for handling this grain traffic. The importance of that system to the Union Pacific in such an event can easily be seen. In the meantime its possession would give the latter an important connection with Chicago.

It was these ideas just as much as that of finding a good investment for the Union Pacific's funds which impelled Mr. Harriman to advise his company to pay $175 a share for Illinois Central stock and to buy Railroad Securities stock on the same basis. The fact that a large portion of both of these stocks was purchased from Mr. Harriman himself, and that he had acquired them at a much lower cost in years long previous, might be made the basis of criticism by his enemies. Fair consideration, however, will deprive it of any significance.

The above described stock purchases, we have intimated, might be considered to be the reinvestment of funds liberated, or rather borrowing capacity created, by the conversion into common stock of the Union Pacific's bond issue of 1901. The conversion of those bonds also made another financial measure possible. It reduced the fixed charges to the extent of $4,000,000 a year, through the conversion of an interest into a dividend claim. This, together

*The purchase of the greater portion of the capital stock of the old Chicago & Alton Railroad Company, made in 1899 by Mr. Harriman and three of his associates, that company's subsequent sale of a thirty-two million-dollar bond issue at $650 per 1,000-dollar bond out of the proceeds of which a 30 per cent. dividend was distributed to its stockholders, the recapitalization of this system through the organization of the Chicago & Alton Railway Company, the subsequent loans made to the latter company by Mr. Harriman in order to enable it to pay its preferred dividends, and the more recent consolidation of these two corporations into one—all this would make an interesting story. But to tell it would unduly extend this narrative; and, since the transactions were the private activities of Mr. Harriman and his associates rather than of the Union Pacific, a description of them has been omitted.

with the rapidly increasing earning power of the system, placed the Union Pacific in a position where it could finance a part of its further capital requirements by means of the sale of preferred stock instead of bonds. The truth of this statement will be evident if one considers that, although the interest charge which disappeared in the bond conversion was replaced by a much larger claim upon earnings for the payment of dividends, yet these dividends were upon common stock. Any new preferred stock which might be sold would present a claim for dividends which would be superior to that of the common stock. Such preferred stock ought to sell well, because after the conversion of those bonds a much larger portion of the net earnings would be left for dividend purposes.

It was this consideration which actuated the Union Pacific in its authorization, in April, 1905, of an increase to the extent of $100,000,000 in its preferred stock. The issuance of such stock at this time, had the capital requirements of the company necessitated the creation of some new security, would have been in accordance with a conservative and wise financial policy, for it would have economized the credit of the company. It would have left unimpaired the company's ability to issue bonds at a later date, should its need for capital funds again become pressing. However, although authorized for some unnamed "lawful corporate purposes," none of this preferred stock has been issued.

During all this time the Union Pacific had not been idle in its traffic department and in its work of building up its system internally. The growth of traffic earnings, income from investments and other sources, net income available for dividend payments, dividends, surplus income, and the appropriations therefrom for betterments and equipment are represented in the following table:

Union Pacific Operations.
(000 omitted.)

	1900.	1901.	1902.	1903.	1904.	1905.	1906.
Gross earnings	$39,148	$43,538	$47,500	$51,075	$55,279	$59,325	$67,282
Net earnings	18,952	20,201	23,311	23,735	26,253	28,954	32,020
Income from investmts. etc.	2,744	3,221	4,581	4,648	5,520	6,497	10,330
Gross income	21,695	23,422	27,891	28,383	31,772	35,451	42,350
Fixed charges	9,108	9,825	13,388	13,107	13,922	12,665	10,586
Net income	12,588	13,598	14,503	15,277	17,850	22,786	31,765
Dividends	7,744	8,420	8,197	8,333	8,333	10,087	19,532
Bettermts & equipmts.	2,000	1,500	2,000	2,000	3,500	4,479	4,200
Other adjustments*	+2,403	.....	+220	—5,173	+110	+385	+125
Net surplus	5,247	3,678	4,526	—229†	6,127	8,605	8,158

*Net increase to income, + ; net decrease, —.
†Net deficit.

The enormous increase between 1900 and 1906 of $28,134,000 in gross earnings is seen at a glance. This is nearly 42 per cent. Not less striking, the net earnings have increased $13,068,000, or 69 per cent. This shows economy in the operating department. This economy has not been secured by under-maintaining the property or equipment, however, for the Union Pacific, like the Southern Pacific, makes maintenance expenditures which are well above the average of those on other systems.

Probably the most remarkable line in the table is that representing the income from investments, loans, etc., showing an increase in this income from $2,744,000 to $10,330,000. The amount for 1906 was more than sufficient to pay half of the dividends of that year, and exceeded the entire amount of the dividends distributed in 1905. The increase in this income has been most marked within the last year included in the table, and is due in part to the commencement of dividends on Southern Pacific common stock, in part probably to the interest on the $34,710,000 of "Demand Loans" spoken of above. Owing to these increases in income and to a reduction in fixed charges in recent years, due to the conversion of the 4 per cent. bonds of 1905, the net income available for the payment of dividends has increased at an even greater rate, namely, $19,177,000, or 152 per cent.

The dividend payments have grown rapidly since 1904. This is due to two causes; namely, an increase in the rate to common stockholders and the aforesaid conversion of bonds into that stock. In September, 1905, the common stock was placed on a 5 per cent. basis. In April, 1906, it was advanced to 6 per cent. Finally, for October, 1906, it was placed at 10 per cent., the semi-annual dividend of 5 per cent. being payable 3 per cent. from earnings and 2 per cent. from the income from investments.

The manner in which this last dividend was announced has brought upon Mr. Harriman and his associates probably more deserved criticism than any other act. The boards of directors of the Southern Pacific Company and of the Union Pacific Railroad Company met in the same room at practically the same time. The former transacted its business first. The enormous growth in that company's net earnings, its directors thought, justified them in commencing the payment of dividends to the common stockholders, and accordingly that stock was placed on a 5 per cent. basis. The Union Pacific board then transacted its business, declaring the customary 2 per cent. semi-annual dividend on its preferred stock and the common stock dividend, as described above. So far all is well. But a report concerning these actions was not given out until two days afterwards. When this report should finally be given forth, both the Union Pacific and Southern Pacific stocks would rise many points, as they did rise afterwards, on the market. Here was an excellent opportunity for those with foreknowledge to reap millions of profits by buying these stocks at the existing prices and selling them on the advance. Whether this was actually done, no one knows but those who had this knowledge, namely, the directors of the two companies. Mr. Harriman explained the delay by saying that two of the Union Pacific's directors were not present at the first meeting, and he thought it advisable to inform them of the action before making a public announcement. This may be all true, and those who were in possession of the confidential knowledge may not have used their knowledge to gain a single dollar for themselves. Yet it does not seem that the importance of giving those other two directors advance information was great enough to warrant the giving of such an *opportunity* for amassing ill-gotten gains.

But, after paying dividends amounting to 10 or 20 millions of dollars, the company has had vast sums left for betterments and other purposes. For instance, in 1905, $4,479,000 was spent upon or appropriated for betterments and equipment, and charged against the surplus account, yet $8,605,000 remained of the year's earnings to increase the formal surplus. In 1906, after paying $19,532,000 in dividends and after charging another $4,200,000 against the surplus account for similar purposes, it again had $8,158,000 to carry to its surplus account. This surplus, too, it must be remembered, is not kept in the form of idle cash, but is also expended upon betterments, in the purchase of additional new equipment, or by way of advances to other companies (notably the San Pedro, Los Angeles and Salt Lake) to aid them in the construction of their properties. Its use differs from the previously mentioned appropriations only in that the cost of these things is added to the "cost of railroads and equipment" account or carried as "advances for construction," *i.e.*, is treated as a capital expenditure instead of being technically classed as an expense, and deducted from "surplus income."

The financial strength, and, yes, we may even say the financial conservatism, of the Union Pacific Railroad Company are brought out in the above description. A brief restatement of certain facts will throw the policy of the Union Pacific management more strongly into relief. Mr. Harriman has enforced for this company the highest standard of maintenance for roadway and equipment of any railroad system west of the Mississippi river. The expenditure for maintenance of freight equipment until 1904 was, perhaps, somewhat below the standard set by other systems, being about 4½ mills per mile run (for freight cars) as compared with 5 to 6 mills on other lines; but the Union Pacific's expenditure on this branch of the equipment rose to 6.13 mills in 1905 and 6.87 mills in 1906—figures which are as much above the standard as the earlier amounts were below it. The expenditure for the maintenance of the passenger equipment during the last five years has averaged 1.25 cents per mile run of those cars, or more than 25 per cent. more than is expended by other western companies. To maintain the locomotive equipment, the company has allowed an average of about 9.82 cents per mile run, or 50 per cent. more than comparative statistics would indicate as necessary to keep this branch of the equipment in good operating condition. The alkaline character of the water used in the boilers over a considerable portion of the system will account for a part of the excessive allowance for locomotive maintenance, but not for all of it. These expenditures mean that, as the company's equipment wears out, it is replaced with more capacious and better equipment, the entire cost of which is charged as an expense; they mean, also, that the old equipment is sent to the scrap heap earlier in its life than is similar equipment on other systems.

In a similar manner the Union Pacific has allowed an average, during the last five years, of $1,256 per mile per annum to maintain its roadway, while other western companies have been expending only $800 and $900 per mile on their lines. These expenditures result in giving the Union Pacific an excellent roadbed and track over which to roll its traffic and an adequate equipment with which to handle it economically.*

All of these liberal maintenance allowances the Union Pacific charges as a part of the expense of operation. They are taken into account before net earnings are ascertained. Yet, in spite of their great magnitude, the company has the large net earnings indicated in the table exhibited above—earnings which are large enough to pay fixed charges of nearly $10,600,000 and the huge dividends of over $19,500,000 distributed in 1906, and still leave a surplus reserve of nearly $2,000,000 for other purposes. But to these earnings the company adds a vast sum—it was more than $10,300,000 in 1906, and will approximate $14,000,000 in 1907—received as income from investments in the stocks of other railroad systems. In fact, the Union Pacific could completely abandon the operation of its railroad lines and still receive, as tribute from the Alton, the Atchison, the Baltimore & Ohio, the North-Western, the St. Paul, the Illinois Central, and the other great railroad systems whose stocks it owns, enough income to pay its fixed charges and the customary 4 per cent. dividends on its preferred stock.

*For a striking comparison between the financial strengths and management policies of the Union Pacific and its great rival, the Great Northern, see the *Wall Street Journal* for June 26, 1907.

Live Rail Accidents in England.

It is clear that the North Eastern does not desire to conceal its satisfaction with electric traction working. It has found it just the help that was required in meeting the electric trolley car competition which sucked away its traffic in the district about Newcastle in its pre-electric days. At the last half-yearly meeting it was shown that though the cost of electrical working had shown a slight increase caused by the running of a larger number of trains and car miles, the receipts have made a more than corresponding increase, with the result that the takings for these sections have now got back to practically what they were when the tramways began running. The length of route of running lines is 29.5 miles electrical operated on a 600-volt, direct-current system, with multiple unit control.

It will be remembered that three to three and a half years ago, when the converted lines were opened, there was some disquiet occasioned by the number of accidents that occurred through trespassers and some employees coming into contact with the third rail. The same experience was also recorded in the case of the Lancashire & Yorkshire Liverpool-Southport section. As time has worn on it has been shown that these disasters were largely due to unacquaintance with the conditions attending live rail traction. The railroad authorities took special precautions for preventing trespassers from finding their way on to the track and for the guarding of the third rail at exposed places. Additional bridges were erected in the neighborhood of certain of the crossings, and these various measures together with a better knowledge of the danger on the part of the public and railroad employees, have led to a very gratifying falling off in the fatalities.

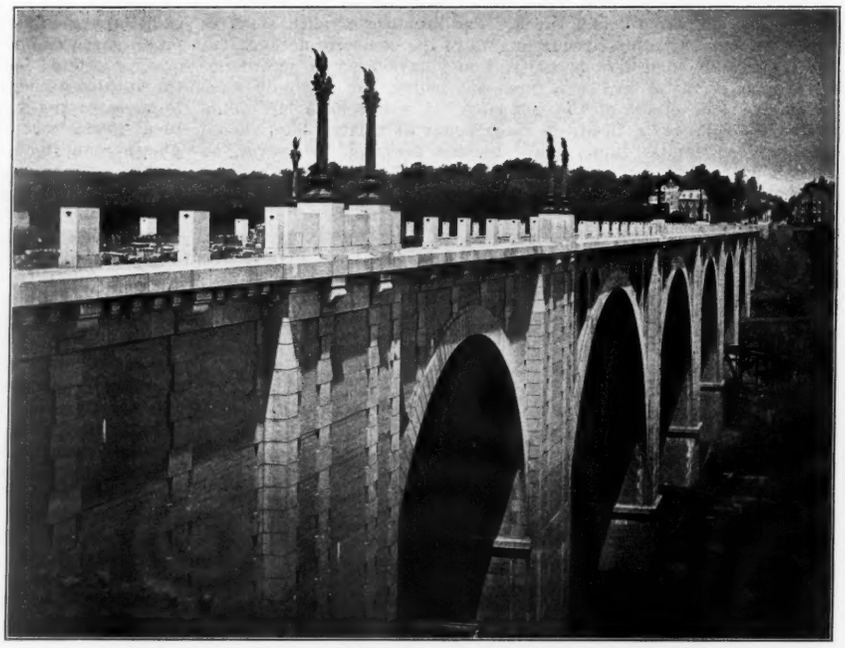
English electrical experts are quiet again just now, but the danger of the live rail between tracks was one of their strong arguments in favor of the single-phase alternating-current system. The statistics that have been officially compiled of the live rail fatalities during 1906 will not help them in that argument, whatever may be the relative merits of the two systems on other grounds. The only shock fatality—apart from those of trespassers—was to a railroad employee. The only other deaths were those of three trespassers. Of these four, one occurred on the Lancashire & Yorkshire, one on the Metropolitan District and two on the North Eastern. There were 21 persons injured, and of these 10 were railroad employees and eight were trespassers.

These four deaths and 21 injury cases in 1906 on eight electric systems may be compared with eight deaths and 20 injuries in 1904, when only three of the railroads were electrified, and it is at once clear that the better guarding of the rail, the publishing of placard warnings, better fencing, and a closer knowledge of potential danger on the part of employees and the public, have been in a great measure effectual.

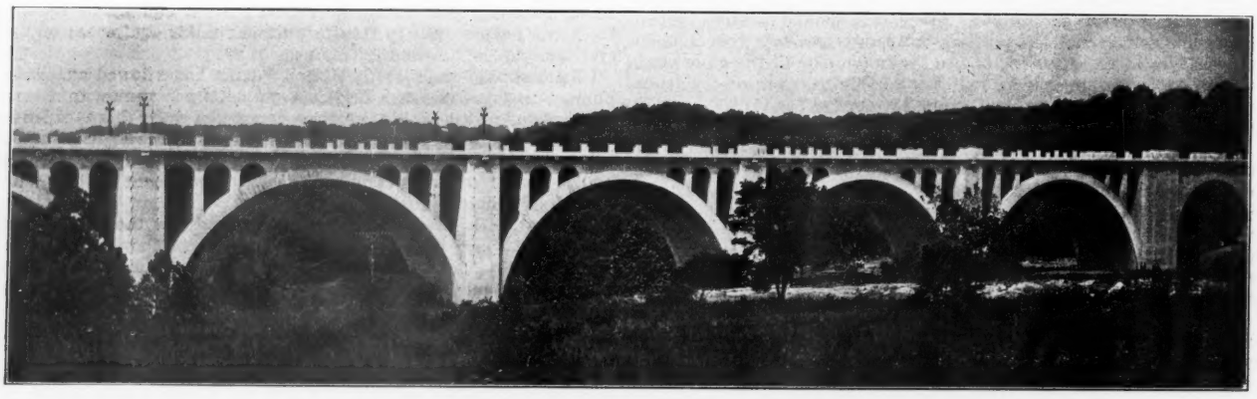
Experience in England in all departments of electrical application is showing how necessary it is that the worker in the vicinity of live apparatus or conductors should be fully warned concerning the possible dangers attending his employment. An examination of recent returns shows that carelessness, recklessness and foolhardiness are responsible for far too many fatalities. It has been the custom in power stations of all kinds, and latterly on electric railroads, to circulate illustrated wall sheets and pocket pamphlets describing the most effective methods of handling a man under shock, and this is an instructive warning. The Government Department (Home Office) dealing with such matters is about to order the use of such wall sheets in all factories where electricity is used at above 130 volts continuous and 65 volts alternating.

The Connecticut Avenue Concrete Bridge at Washington, D. C.

The concrete arch bridge carrying Connecticut avenue over Rock creek gorge in the outskirts of Washington, D. C., is now nearly completed. It consists of five main arches, full centered and of 150-ft. span, and one small flanking arch of 82-ft. span at each end. With the abutments it has a total length of 1,341 ft., and the roadway is 125 ft. above the level of Rock creek. It carries a 35-ft. roadway and two 8-ft. sidewalks and is 52 ft. wide over the faces of the arch rings. The roadway is carried over the haunches of the main arches by seven spandrel arches of 14-ft. span supported on piers 3 ft. thick, the middle arch being blanked by a face wall carried up from the piers. The main arch piers are 20 ft. thick and rest on rock foundations; the abutment piers next to the flanking arches are 31 ft. thick. The arch rings are monolithic concrete without reinforcement and are 5 ft. thick at the crown. All the quoins, ring stones, mouldings, etc., are molded concrete faced with mortar and bush hammered to give the same finish as the granite balustrades and coping. In all, nearly 60,000 yds. of concrete have been used in the superstructure and 50,000 yds. of earth filling.



The Connecticut Avenue Bridge; View from the South End.



The Connecticut Avenue Bridge over Rock Creek, Washington, D. C.

The District Construction Co., of Washington, D. C., was the contractor for the superstructure. The bridge cost nearly $1,000,000, and was designed and built under the direction of W. J. Douglas, Engineer of Bridges for the District of Columbia.

Locomotive Boiler Inspections in New York State.

The Legislature of New York last spring amended the requirements for locomotive boiler inspection to read substantially as follows:

Inspection of Locomotive Boilers.—It shall be the duty of every railroad corporation operated by steam power, within this state, and of the directors, managers, or superintendent of such railroad to cause thorough inspections to be made of the boilers and their appurtenances of all the steam locomotives which shall be used on said railroads. Inspections shall be made, at least every three months under the direction of said corporation by persons able to perform the services required of inspectors of boilers, and who from their knowledge of the construction and use of boilers and the appurtenances therewith connected, are able to form a reliable opinion of the strength, form, workmanship and suitableness of boilers, to be employed without hazard of life, from imperfections in material, workmanship or arrangement of any part. All boilers shall comply with the following requirements: The boilers must be made of good and suitable materials; the openings for the passage of water and steam respectively, and all pipes and tubes exposed to heat shall be of proper dimensions; the safety valves, fusible plugs, low water glass indicator, gage cocks and steam gages, shall be of such construction, condition and arrangement that they may be safely employed without peril to life; and each inspector shall satisfy himself by thorough examination that said requirements have been fully complied with. No boiler, nor any connection therewith shall be approved which is unsafe in its form, or dangerous from defects, workmanship or other cause. The inspector if he approve of the boiler and appurtenances throughout, shall make a certificate which shall contain the number of each boiler inspected, the date of its inspection, the condition of the boiler inspected, and such details as may be prescribed by the railroad commissioners. Every certificate shall be verified by oath and shall be filed in the office of the railroad commissioners, within ten days after each inspection, and also a copy thereof with the chief operating officer or employee of such railroad having charge of the operation of such locomotive boiler; a copy shall also be placed in a conspicuous place in the cab connected with the locomotive boiler inspected, and there kept framed under glass. The railroad commissioners shall have power to formulate rules and regulations for the inspection and testing of boilers. If it shall be ascertained by such inspection and test or otherwise, that any locomotive boiler is unsafe for use, the same shall not again be used until it shall be repaired, and made safe. Every corporation, director, manager or superintendent operating such railroad and violating any of the provisions of this section shall be liable to a penalty of $100 for each offense, and the further penalty of $100 for each day they shall neglect to comply with said provision, and the making or filing of a false certificate shall be a misdemeanor, and every inspector who wilfully certifies falsely touching any steam boiler, or appurtenance, or any matter contained in any certificate, signed and sworn to by him, shall be guilty of a misdemeanor. Any person, upon application to the secretary of the board of railroad commissioners, and on the payment of a reasonable fee shall be furnished with a copy of any such certificate.

Care of Steam Locomotives; Steam and Water Cocks; Penalty.—It shall be the duty of every corporation operating a steam railroad within this state, and of its directors, managers or superintendents, to cause the boiler of every locomotive used on such railroad to be washed out as often as once every 30 days, and to equip each boiler with, and maintain thereon at all times, a water glass, showing the height of water in the boiler, having two valves or shut-off cocks, one at each end of such glass, which valves or shut-off cocks shall be so constructed that they can be easily opened and closed by hand; also to cause such valves or shut-off cocks and all gage cocks or try cocks attached to the boiler to be removed and cleaned whenever the boiler is washed out, also to keep all steam valves, cocks and joints, studs, bolts and seams in such repair that they will not at any time emit steam in front of the engineer, so as to obscure his vision. No locomotive shall hereafter be driven in this state unless the same is equipped and cared for in conformity with the provisions of this section; but nothing here contained shall be construed to excuse the observance of any other requirement imposed by this chapter upon railroad corporations, their directors, officers, managers and superintendents. Every corporation, person, or persons operating a steam railroad and violating any of the provisions of this section, shall be liable to a penalty of $100 for each offense, and the further penalty of $10 for each day that such violation shall continue. The board of railroad commissioners shall enforce the provisions of this act.

The law went into effect September 1, and on August 20 the Public Service Commission, Second district, which assumed all of the duties of the State Railroad Commission mentioned in the Act, issued complete instructions and regulations for inspecting, testing and washing locomotive boilers together with forms for making reports. The regulations are as follows:

GENERAL CONSTRUCTION AND SAFE WORKING PRESSURE.

The chief mechanical officer of each railroad company will be held responsible for the general design, construction and inspection of the locomotive boilers under his control. The safe working pressure for each locomotive boiler shall be fixed by the chief mechanical officer of the company or by a competent mechanical engineer under his supervision. The safe working pressure must be determined in accordance with calculations of the various parts after full consideration has been given to the general design, workmanship and condition of the boiler.

INSPECTION OF INTERIOR OF BOILER.

(a) *Time of Inspection.*—The interior of every boiler shall be thoroughly inspected before the boiler is put into service, and also whenever a sufficient number of flues are removed to allow examination.

(b) *Flues to be Removed.*—All flues shall be removed at least once every three years and a thorough examination made of the entire interior of the boiler. After the flues are taken out, the inside of the boiler must have the scale removed and be thoroughly cleaned.

(c) *Method of Inspection.*—The entire interior of the boiler must then be examined for cracks, pitting and grooving. The edges of plates, all laps, seams and points where cracks and defects are likely to develop, or which an exterior examination may have indicated, must be given an especially minute examination. It must be seen that braces and stays are taut, that pins are properly secured in place, and that each is in condition to support its proportion of the stress.

(d) *Repairs.*—Any boiler developing cracks in the shell shall be taken out of service at once and thoroughly repaired before it is reported to be in satisfactory condition.

(e) *Lap Joint Seams.*—Every boiler having lap joint longitudinal seams without reinforcing plates shall be examined with special care to detect grooving or cracks at the edges of the seams.

INSPECTION OF EXTERIOR OF BOILER.

The jacket and lagging shall be removed at least once every three years, and also whenever the inspector considers it desirable or necessary in order to thoroughly inspect the boiler.

TESTING BOILERS.

(a) *Time of Testing.*—Every boiler before being put into service, and at least once every 12 months thereafter, shall be subjected to hydrostatic pressure 25 per cent. above the working steam pressure.

(b) *Removal of Dome Cap.*—Preceding the hydrostatic test the dome cap and throttle pipe must be removed and the interior surface and connections of the boiler examined as thoroughly as the conditions permit.

(c) *Foreman to Witness Tests.*—When boilers are being tested by hydrostatic pressure the foreman of the shop having under his charge the repairs of boilers, or an authorized competent boilermaker, shall personally attend and assist the inspector in his examination.

(d) *Repairs and Steam Test.*—When all necessary repairs have been completed, the boiler shall be fired up and the steam pressure raised to not less than the allowed working pressure.

STAY BOLT TESTING.

(a) *Time of Testing Rigid Bolts.*—All stay bolts should be tested at least once every month, and no boiler must be used over three months under any circumstances unless thorough stay bolt inspection has been made. Stay bolts shall also be tested immediately after every hydrostatic test.

(b) *Method of Testing Rigid Bolts.*—The inspector must tap each bolt from the firebox side and judge from the sound or the vibration of the sheet which of them are broken. If stay bolt tests are made when the boiler is filled with water there must be not less than 50 lbs. pressure on the boiler. This will produce sufficient strain upon the stay bolts to cause the separation of the parts of the broken ones. Should the boiler not be under pressure the test may be made after draining all the water from the boiler, in which case the vibration of the sheet will indicate any unsoundness. The latter test is preferable.

(c) *Method of Testing Flexible Stay Bolts.*—All flexible stay bolts having caps over the outer ends shall have the caps removed at least once every year, and also whenever the inspector considers the removal desirable in order to thoroughly inspect the stay bolts. The firebox sheets should be examined carefully at least once a month to detect any bulging or indications of broken stay bolts.

(d) *Broken Stay Bolts.*—No boiler must be allowed to remain in service when there are two adjacent stay bolts broken in any part of the firebox or combustion chamber, nor when three or more are broken in a circle 4 ft. in diameter.

(e) *Tell Tale Holes.*—All stay bolts shorter than 8 in. applied after September 1, 1907, except flexible bolts, shall have tell tale holes $^5/_{16}$ in. diameter by 1¼ in. deep or more in the outer end. These holes must be kept open at all times, and must not in any case be plugged. All stay bolts shorter than 8 in., except flexible bolts, shall be drilled when the locomotive is in the shop for heavy repairs or at other suitable opportunity, and this work must be completed prior to January 1, 1909.*

STEAM GAGES.

(a) *Location of Gage.*—Every boiler shall have at least one steam gage which will correctly indicate the working pressure. Care must be taken to locate the gage so that it will be kept reasonably cool, particularly in case of gages located on the back head of boilers.

(b) *Siphon.*—Every gage shall have a siphon of ample capacity to prevent steam entering the gage. The pipe connection shall enter the boiler shell direct, and shall be maintained steam tight between siphon and gage.

(c) *Time of Testing.*—Steam gages should be tested at least once every month, and no boiler must be used over three months under any circumstances unless a thorough test has been made of the steam gage.

*Applications from companies desiring to omit the use of tell tale holes will be considered when it can be shown to the satisfaction of the commission that unusual care is used in stay bolt testing, both as to the frequency of tests and the selection of inspectors.

SAFETY VALVES.

(a) *Number and Capacity.*—Every boiler shall be equipped with at least two safety valves, the capacity of which shall be sufficient to prevent, under any conditions of service, an accumulation of pressure of more than 5 per cent. above the allowed steam pressure.

(b) *Setting of Valves.*—Safety valves shall be set by the gage employed upon the boiler, to pop at pressures not exceeding 5 lbs. above the allowed steam pressure, the gage in all cases to be tested before the safety valves are set or any change made in the setting. When setting safety valves the water level in the boiler must not be above the highest gage cock.

(c) *Time of Testing.*—Safety valves should be tested under steam at least once in every month, and no boiler must be used over three months under any circumstances unless the safety valves have been thoroughly tested.

WATER GLASS AND GAGE COCKS.

(a) *Number and Location.*—Every boiler shall be equipped with at least one water glass and three gage cocks. The lowest gage cock and the lowest reading of the water glass shall not be less than 3 in. above the highest part of the crown sheet.

(b) *Water Glass Valves.*—All water glasses shall be supplied with two valves or shut-off cocks, one at the upper and one at the lower connection to the boiler, and also a drain cock, so constructed and located that they can be easily opened and closed by hand.

(c) *Time of Cleaning.*—All gage cocks and water glass cocks shall be removed and cleaned of scale and sediment whenever the boiler is washed.

PLUGS IN FIRE TUBES.

(a) *Plugs Prohibited.*—No boiler shall remain in service which has one or more fire tubes plugged at both ends of the tube unless the plugs are securely tied together by means of a rod not less than ⅝ in. diameter.

WASHING BOILERS.

(a) *Time of Washing.*—All boilers shall be thoroughly washed not less frequently than once in 30 days.

(b) *Plugs to be Removed.*—When boilers are washed all washout, arch and water bar plugs must be removed.

(c) *Water Tubes.*—Special attention must be given the arch and water bar tubes to see that they are free from scale and sediment.

(d) *Office Record.*—An accurate record of all locomotive boiler washouts shall be kept in the office of the railroad company. The following information must be entered on the day that the boiler is washed:

(1) Number of locomotive;
(2) Date of washout;
(3) Statement that boiler was washed;
(4) Signature of the boiler washer or the boiler inspector;
(5) Statement that gage cocks and water glass cocks were removed and cleaned;
(6) Signature of the boiler inspector or the employee who removed and cleaned the cocks.

STEAM LEAKS.

(a) *Leaks Under Lagging.*—If a serious leak develops under the lagging an examination must be made and the leak located. If the leak is found to be due to a crack in the shell or to any other defect which may reduce safety, the boiler must be taken out of service at once and thoroughly repaired before it is reported to be in satisfactory condition.

(b) *Leaks in Front of Engineer.*—All steam valves, cocks and joints, studs, bolts and seams shall be kept in such repair that they will not at any time emit steam in front of the engineer, so as to obscure his vision.

FILING OF REPORTS.

(a) *Specification Card.*—A specification card containing the results of the calculations made in determining the working pressure and other necessary data shall be filed in the office of the Public Service Commission, Second district, for each locomotive boiler. A copy shall also be filed in the office of the chief mechanical officer having charge of the locomotive. Every specification card shall be verified by the oath of the engineer making the calculations, and shall be approved by the chief mechanical officer. These specification cards shall be filed as promptly as thorough examination and accurate calculation will permit. Where accurate drawings of boilers are available, the data for specification card may be taken from the drawings, and such specification cards must be completed and forwarded prior to March 1, 1908. Where accurate drawings are not available, the required data must be obtained at the first opportunity when general repairs are made, or when flues are removed. Specification cards must be forwarded within one month after examination has been made, and all examinations must be completed and specification cards filed prior to January 1, 1909, flues being removed if necessary, to enable the examination to be made before this date.

(b) *Certificate of Inspection.*—Not less than once in three months and within 10 days after each inspection, a certificate of inspection shall be filed with the Public Service Commission, Second district, for each locomotive boiler used by a railroad company, and a copy shall be filed in the office of the chief officer having charge of the locomotive. A copy shall also be placed under glass in a conspicuous place in the cab of the locomotive before the boiler inspected is put into service. Each certificate shall give the number and the condition of the boiler inspected, the date of the inspection and other required details, and each certificate shall be verified by the oath of the inspector.

(c) *Reporting Washouts.*—The inspector shall examine the record of boiler washouts on file in the company's office not less frequently that once every three months, and if he is satisfied of its accuracy he shall enter the dates of every washout made during the preceding three months on the certificate of inspection. In case the record is not satisfactory the inspector shall make notation thereof on the certificate.

COPIES OF REGULATIONS.

The chief mechanical officer of each railroad company shall keep each inspector of locomotive boilers under his supervision supplied with a copy of these regulations. Copies can be obtained upon application to the Secretary of the Public Service Commission, Second district, Albany, N. Y.

Track Work Involved in the New York Central's Reversal of the Direction of Traffic.

In the *Railroad Gazette* for August 30, page 227, was given some account of the signal work made necessary by the change from left-hand running to right-hand running, on August 25, of trains on the Harlem Division within the Electric Zone. In addition to this, the track work involved was considerable and interesting, because only a part of the construction could be entirely completed beforehand, and all connecting up and putting in service was concluded in about twelve hours.

The entrances to the tail-end yards were previously revised so as to make a trailing switch entrance from the new direction of traffic. This caused a substantial rebuilding of the yards with the installation of new switches, the building of roadways, and in two cases the previous moving of the freight houses to locations where they could be used both before and after the change. It involved also much work in taking care of the industries affected and the making of new leases and negotiations for private sidings. The crossovers in main tracks were reversed, and in some cases the locations were revised. The new crossovers were installed beforehand and spiked ready for service where it was possible to do this. Wherever the old crossovers prevented this anticipation of a change as much work as possible was done beforehand. The rails were cut and material was at hand for a quick completion of the work. The inner guard rails were pointed for the new direction of traffic. Bridge ticklers were erected to warn trainmen on top of cars that they were approaching an overhead obstruction. There were forty-two bridges for which tell-tales were required.

In the main tracks rigid crossing frogs were replaced by movable point frogs and the electric circuit was designed to prevent the switches being thrown under a train. This did away with the unprotected portion of the rigid crossing formerly in use and substituted a continuous rail for traffic which should outlast the old ararngement and make an easier riding track.

At the Harlem river draw bridge the lift rails have mitered ends fitting those which they meet on the draw. These mitered ends must have their chisel edges pointed away from the direction of traffic, and, due to the reversal, this whole construction needed to be taken out and changed so as to make the points trailing. This meant removing 1,150 ft. of rail in the four tracks, substituting new insulators and insulated tie-rods and clips. As the track is on a steel structure, this was precise work. The new track had to be drilled for the negative return current from operation, and this single item, drilling and bonding cost $475 during the 15 hours in which the change was made.

The point of departure of the New Haven track from the Harlem track was shifted to a place one-quarter mile south from the old junction. From the Grand Central Station to this point the double-equipped New Haven electric motors are fed with direct current from the under contact third rail. Here they change to the overhead contact with alternating current. This point, therefore, becomes a new third rail terminal. The new construction involved a change of colors in about 1,200 lights in switch lamps and repainting the switch targets to conform to the new color indications. The change in color indications involved an additional complication both in construction and in practice in drilling the men. Green instead of white now means proceed and yellow means caution. The changes necessitated the quick use of many barrels of paint and many thousand carefully chosen words used in lectures to the men. There was also a change in nomenclature in which the men had to be drilled. The numbers by which the main tracks were known were reversed in order, the westerly main track became No. 1 and the other tracks numbered consecutively eastward, so that the easterly track became No. 4. At the same date a new time table went into effect, so that nearly every one on the line was kept busy in learning new things.

At Mott Haven Junction the electro-pneumatic controlled manual signals were kept in operation, but were rebuilt and modernized during the period of change. During this period the trackmen threw the switches by hand, flagged trains and set up routes through this busy junction under the direction of the towermen. The trackmen were also used as watchmen and inspectors of the condition of tracks at every spot where changes were made.

The adaptation of northbound tracks to southband running involved a revision of the superelevation of track on many curves. The grades and reversal of approaches and departures at stations made material changes in possible speed and in operating limitations to speed. New calculations were made and the heights of the outer rail were readjusted.

The pneumatic interlocking plants have been heretofore arranged for a switch throw of 4 in. The new interlocking plants are arranged for a throw of 5 in. The track work involved in this change was considerable. All switch rods in these plants were insulated and were redrilled for the wider throw. This was work of precision and accuracy, and to secure it all available draftsmen and instrumentmen were detailed to measure and inspect the progress of the work.

The changing of the position of signs and the making of new signs on the track and at stations was also a considerable undertaking. Almost everything of this character had to be moved to new places. Slow order signs, resume speed signs, yard limit signs, all and many others were changed. Notices to the public in the stations were changed so as to guide all except absent-minded persons to the proper departure place of trains, and new notices, conspicuously placed, were put up to assist in this. This included the signs adjacent to the tracks in the waiting-rooms and on the stations. There was a change in the lighting of the signs in Park avenue tunnel and also a making, painting and placing of signs on the new towers, designating those towers as described in the train orders. Involved, too, in this same department of the work was the moving of the benches on the platforms. These are required principally near those tracks used by outgoing passengers, and a change in the direction of traffic meant a change in the bench location at all places where the platforms are separated into two groups.

At 125th street station it was necessary to extend the platform south, so that the baggage cars could stop near the baggage elevator and still allow landing platform room for passengers.

At Claremont Park the new southerly entrance to the freight yard went through the passenger platform. An overhead bridge has been designed from the overhead station to the platform to allow for this, but has not yet been received. To allow for the change it was necessary to shift the canopy back, make temporary stairs and platform for passengers to walk across this entering track.

At the Harlem river drawbridge the new location of the tower and the new signal interlocking made necessary new rules for communication between the bridge foreman and the towerman controling the opening of the draw.

The changes in third rail were such as were needed to allow for track changes, and an adaptation of third rail to the new direction of operation. The two-bolt angle plates connecting the third rails were bolted tightly on the receiving end of the third rail, but loosely on its leaving end. The idea of this was to allow more room for expansion, as the bolts are covered by the sheathing and cannot be readily loosened and tightened in changing temperature. The location of the third rail appeared all right, except when forced upward by the shoe of a passing train, at which time a slight lip or jog was caused between the ends of the adjacent rails. To tighten these bolts meant taking off the sheathing at all joints throughout the Electric Division. All end inclines were carefully gaged in the new direction of traffic and test trains were run against traffic to see if any further trouble developed.

To make the change there were employed: General Railway Signal Company men who were responsible for the completion of their contract to erect the new signals; inspectors from the signal engineer who were responsible for the proper inspection and correct working of the new installation; maintainers from the engineer of signals who were responsible for the maintenance and care of the new system.

To co-ordinate the different departments involved in the change, it was decided to have one boss, a director representing the four departments. Mr. H. S. Balliet, Engineer of Signals, was so appointed. All instructions affecting the work were issued through him, so that there would be no chance of confusion or lack of understanding. During the work progress reports were telephoned or telegraphed to Mr. Balliet from each point, and any one wishing to get information about his own work or somebody else's work could find out the condition from Mr. Balliet. To assist in this communication, lists of all public telephones adjacent and available for use, were given to each foreman.

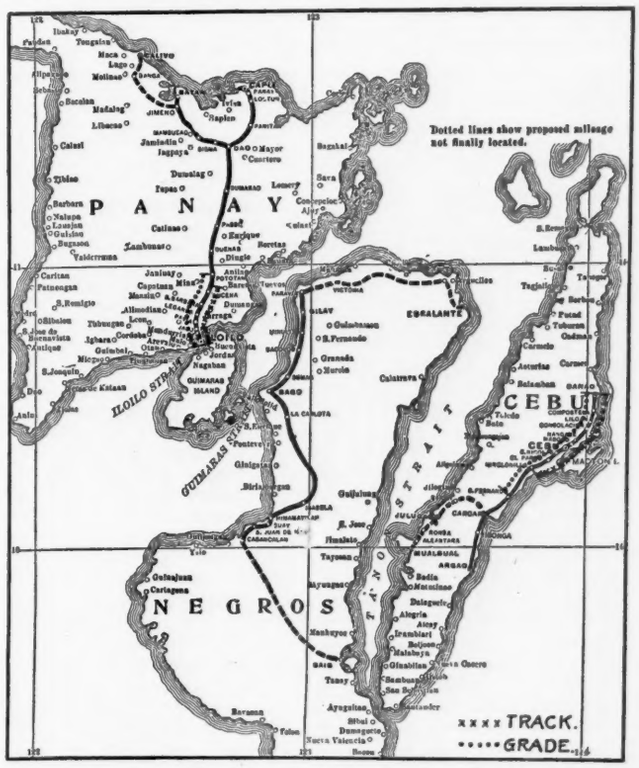
The territory was divided into sections, each one being under the jurisdiction of a signal inspector, who was responsible for the proper carrying out of changes affecting the operating of the signal. As the operation of the signal guided the operation of trains that meant the whole change. With him was a signal company representative, a signal maintainer and a trackman, each with the necessary forces to complete such work as was assigned to him. The time for unspiking the new switches and spiking up the old switches was arranged for in advance, each territory having a programme for each portion of the work issued as a bulletin over the signatures of the four officials in general charge of the work. However, the actual placing in service of these tracks was only done on orders from the director in order to guard against any trouble.

The determining point in the change seemed to be the Harlem river drawbridge. At 7 p.m., August 24, tracks Nos. 2 and 3 were put out of operation, the current on the third rail killed and the work of taking out the old lift rails and installing, bonding and connecting up the new was begun. This was completed together with the signal work about 4 o'clock in the morning, at which time tracks Nos. 2 and 3 went into service for right-hand operation, tracks Nos. 1 and 4 put out of service, and the work of equipping these latter tracks for right-hand running began. This was completed about noon Sunday.

At daylight Sunday morning the work of changing notices to the public and signs affecting movement of trains was begun, and was completed by the time the out-of-town movement for the day began.

Philippine Railroad Building with Filipino Builders.

When the concession for building, equipping and operating the new system of railroads in the Philippine Islands, Panay, Negros and Cebu, was let by the Government in January, 1906, to a syndicate, including Wm. Salomon & Co., Cornelius Vanderbilt, International Banking Corporation, J. G. White & Company and others, under the name of the Philippine Railway Company, the first problem which had to be met was the selection of the chief construction and operating officials. The second problem was that of



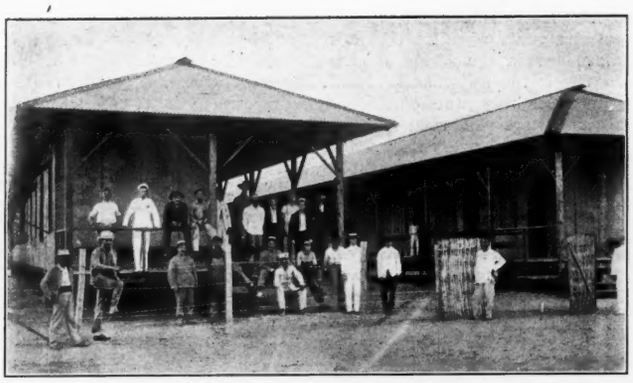
Map of the Philippine Railways in Visayan Islands.

labor, and the third, in part still in process of solution, was the development of standards of construction and equipment best adapted to the conditions. These three primary considerations have been stated in what is estimated to be the order of their importance.

After a careful investigation of the records of several well known railroad construction engineers, whose services were available, the contracting company chose as Chief Engineer for construction Edward J. Beard, Principal Assistant Engineer of the Chicago, Rock Island & Pacific Ry. In organizing the operating staff of the Philippine Railway Company, William B. Poland, formerly on the Baltimore & Ohio Southwestern, was made Vice-President and chief operating officer.

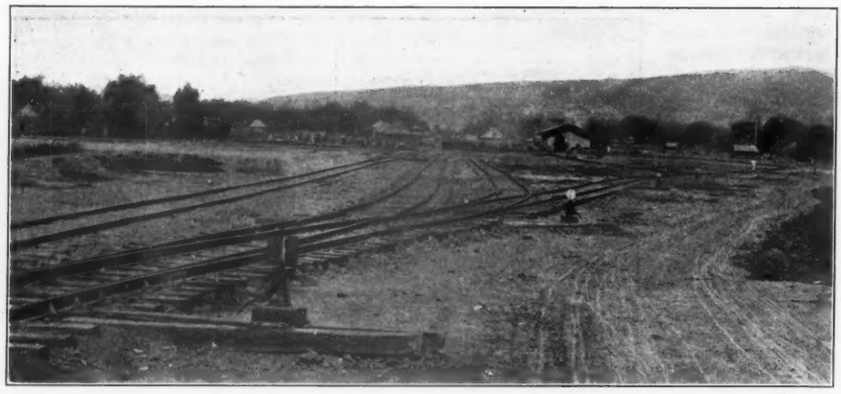
Not until these officers had gone to the Islands and completed close personal studies of the labor conditions in the archipelago generally, and in the Visayan group in particular, was it felt safe to map out the labor policy, the second important problem. This

involved primarily the question whether Filipinos should be employed or whether the Government should be asked to let down the bars temporarily and admit Chinese coolies for the work, under deportation bond. There was a strong feeling current among business men experienced in the affairs of the islands that because of the many previous expensive trials of native labor on road making and like work that the Filipinos were not up to this greater job and that Chinese labor would have to be depended on to complete the project. Because of this general trend of opinion it might have been possible to get governmental permission to import Chinamen but no attempt in that direction was ever made. The counsel of Mr. Beard, coupled with the previous successful experience of the contractors, J. G. White & Co., in using natives on the Manila Street Railway and power plant and upon various harbor works, caused the decision to be made in favor of Filipino labor, at the beginning of operations in the summer of 1906. Doubts as to the wisdom of this decision were quite freely expressed by many of those interested in the enterprise, but the decision proved right.



Construction Foremen's Quarters at Lopus Lopus.

Before describing how the details of policy were formulated and how the whole programme has worked out in practice, it is well to outline the successive steps in the organization of the Philippine Railway Co. up to the point of breaking ground. This is the largest railroad project and probably the largest engineering development of any kind ever advanced by Americans over seas without any co-operation or help from foreigners, in addition to being far larger than any single industrial development of any kind previously carried out in the Philippines. Under its franchise, there is conceded to the Philippine Railway Company by the Philippine Commission through special act of Congress, the privilege of building and operating perpetually between 300 and 400 miles of road, almost equally divided between the Visayan islands of Panay, Negros and Cebu, and the 4 per cent. interest on the 30-year gold bonds of the company is guaranteed by the Government. The route and terminals tentatively planned by the Government are shown on the accompanying map. Only after the most exhaustive study of the resources and topography of these islands, through the United States Government records and through reconnaissance surveys by special representatives,* did the associated bankers decide to bid for the work and organize a syndicate to carry it out. These studies indicated potential wealth in the Visayas awaiting for development only the completion of adequate and economical transportation, and these resources quite overshadowed difficulties of construction. Another source of information that should be mentioned was the statistical records of the Spanish priests in the Philippines, about the most valuable documentary heritage of the United States from Spain.

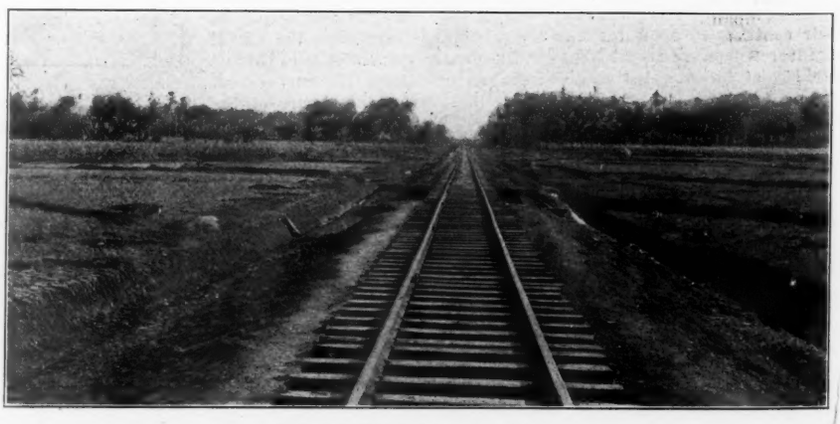


Terminal Yards at Cebu and Construction Tracks.

Throughout these Visayan islands the soil is very fertile. The population varies from 130 per square mile on Negros to more than 300 on Cebu, which is the most thickly populated island of the whole Philippine archipelago. The great staple product is sugar, although in the lowlands considerable rice is cultivated. In the year 1905 Negros, which is the best sugar producer, exported not more than 80,000 tons of sugar, but in the face of a transportation cost of from $20 to $30 per ton in the dry season and an entire lack of transportation in the wet season because of impassable roads. This sugar goes largely to China, the Chinese merchants buying it up in the native markets. This island contains in the uplands also vast untouched forests of the best native hard and soft woods. Other products of the higher country throughout the Visayan group are coffee, cocoa, hemp, copra and other valuable vegetable fibers. Easily as these products are grown, they are produced only in small quantities mostly for local consumption, there being no means of getting them out of the country in bulk. As far as at present discovered, the most valuable mineral resource is coal, a fine grade of high carbon lignite, plentiful on Cebu, which the locomotives on the construction of the railroads are burning, they having been designed for the purpose. These facts of population and resources account for the readiness of the syndicate to offer to build these roads, after determining how the routes lay across tracts of rolling plains and low-lying hills, presenting no great problems of construction other than were likely to be induced by the uncertainty of the labor factor.

The first active step after the selection of the Chief Engineer was the organization of the pioneer corps of locating engineers. This was done in New York by Mr. Beard through his personal knowledge of railroad men and with the aid of the employment records of J. G. White & Company. Successful experience in railroad locating in the tropics was the first consideration in selecting men, and three of the five chiefs of party chosen were so qualified, two of them, H. F. Howe and C. H. Farnham, having been with the Canton-Hankow Railroad in China, where they were respectively Principal Assistant Engineer and Division Engineer, and the third, J. M. Robinson, coming from the Guayaquil-Quito Railroad in Ecuador, where he was Division Engineer. The other chiefs of party chosen were R. F. Ricker, from the Virginia & Carolina Coast, and F. D. Nash from the C., B. & Q., both well known to the Chief Engineer. The engineering corps was recruited up to a complement of 50 men, and they all reported at Kansas City and made the trip to the coast in special cars over the Northern Pacific. On April 26, 1906, they sailed from Seattle on the "Minnesota." This was the first big step toward the fulfillment of the plan of the United States Government to relieve the greatest economic need of the Philippine Islands.

The five locating parties, two for Panay and one each for Negros and Cebu, were made up on the voyage out, and the Cebu party was first in the field, beginning work on June 14, undaunted by the prospect of the tropical rainy season before them. After arriving



A Long Tangent near Cebu.

*See articles by L. E. Bennett, *Railroad Gazette*, Jan. 5, 1906, and Feb. 23, 1906.

Grading a Fill from Borrow Pits.

in their respective territories the other parties lost no time in getting to work and it became a race among the five to see which could make the best showing. Little will ever be known of the fortitude displayed by these little bands of surveyors working in an utterly strange country, toiling through miles of tropical undergrowth and not infrequently cut off entirely from their base of supplies. At times bad trails made packing with animals quite impossible and cargadores or native carriers were the only reliance of the field parties for supplies and transportation. Men accustomed to endure this kind of hardship are generally the last to talk about it, but occasional despatches briefly informing the New York office of the progress of the work, by their very terseness told the tale. So and so pulled out for a bit of a rest; supplies sent in ahead and cachéd to prevent running short again; and once in a long while the bare statement of a resignation, doubtless of some weaker brother unable to endure the strain. The actual test was bound to develop here and there weaknesses that even the searching examination at appointment failed to detect.

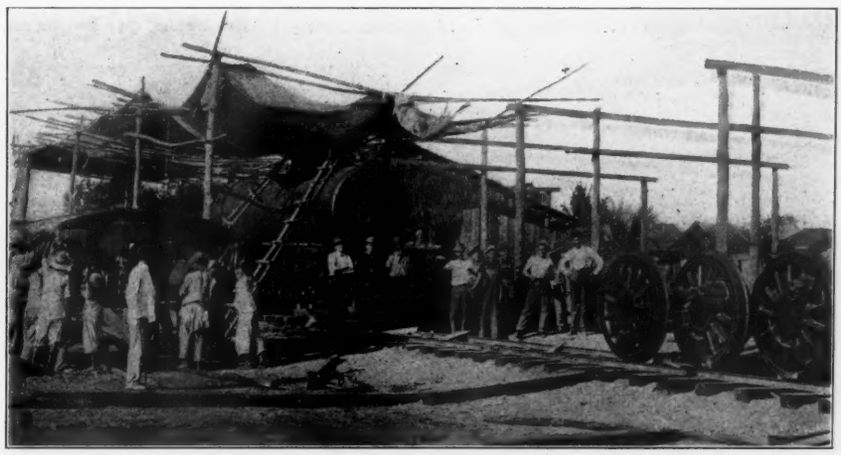
As a whole the locating engineers were admirably well qualified for the work, and all the parties succeeded in demonstrating markedly better routes than were supposed to exist. For example, on Panay between Passi and Dao, a distance of about 20 miles, it was supposed from reconnaissance that a 2 per cent. line would be necessary. After a comparatively long silence when the Chief Engineer had begun to wonder just what they were up to, the party assigned to that section emerged with the news that they had located a 1 per cent. line requiring actually less work than had been expected for the 2 per cent. grade. This is one instance of the character of the work done.

Rapid progress was made considering this careful location, so that by November, 1906, less than five months from the time of landing, nearly all of the main surveys were completed and ground was broken on Cebu. Governor-General Smith turned the first shovel of soil on the fourth of that month. Construction on Panay island was begun soon after, but small surveying parties continued in the field on all three islands some months longer, making tentative locations for possible extensions and branches of the main system.

To date there has been completed nearly 60 miles of grading composing three sections. Track is laid and ballasted on one section, which will probably be placed in operation this month. Track laying is almost completed on a second section. During the summer months the rapid rate of construction established in the spring has been impeded somewhat by unfavorable weather. Forty miles of the advanced construction is on Cebu, half north of Cebu, the chief town, to Danao, the northern terminus of the Cebu lines, and half south of Cebu to Sangai. The other 20-mile section is on Panay island from Iloilo, the metropolis of the southern Philippines, and the southern terminus of the Panay Railroad, to Pototan in the interior north.

Construction has been pushed on Cebu in advance of the other islands because the dense population makes the demand for transportation most acute there. A construction force of about 4,000 natives was organized and the stability and efficiency of this force was so rapidly established that within three months a monthly average rate of 90,000 cu. yds. of earth and about 35,000 cu. yds. of rock was moved, at a cost of only 12½c. per cubic yard. Nothing but hand tools and wheelbarrows and baskets are used, as abundant labor and the heavy shipping expense which would have to be reckoned both ways, render the use of heavy railroad construction equipment impracticable in the Philippines in the present state of development.

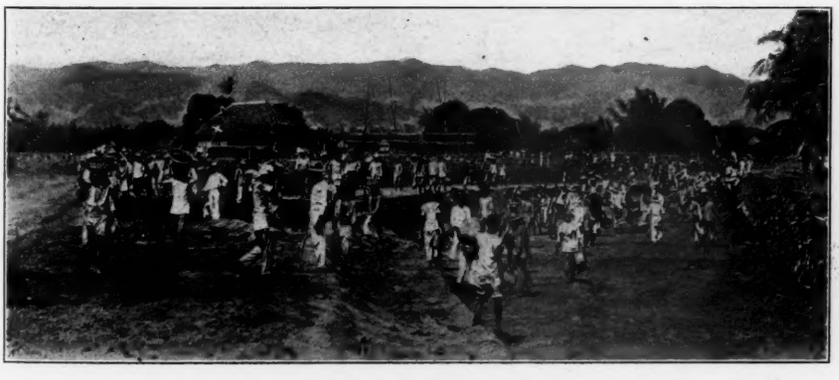
The great majority of the natives engaged were quite unaccustomed to the use of the white man's pick and shovel and wheelbarrow and rock drills, coming as they did from plantations where their own primitive tools were still largely in vogue. It is a native trait to use the hands and feet for working earth and some patience was required to overcome the tendency to drop the new tools and resort to nature's implements whenever the foreman's back was turned. There was also a disposition to try to carry the wheelbarrows after loading on the back. These little idiosyncracies were gradually eliminated, so that in a very few weeks the men were able to use their implements effectively, throwing up embankments four feet high all through a nine hour-shift without serious fatigue.



The First Locomotive Shops of the Philippine Railways.

The experiences encountered on Panay island, where about 2,000 natives have been at work were practically a repetition of those on Cebu, though the island is not so densely populated and some fears were at first entertained as to whether the labor supply would be adequate. Negros is also less densely populated than Cebu, but there now appears good reason to suppose that a sufficient force can be mustered without difficulty among the natives there, though it was at one time thought that labor might have to be imported to some extent from the other islands. Altogether the use of Filipino labor is proving an unqualified success, and the experience thus far is summed up in the opinion of the Chief Engineer, recently stated, that his men were doing work not only better than could ever be achieved by white laborers in the tropics but comparing favorably with the average rate of workmen on railroad work in temperate climates.

Naturally the secret of this achievement lies largely in the administration which has attempted to develop the best qualities in the native character as well as to attract and hold the better element among the laboring populace. First there is the question of wages. Common labor is paid 50 centavos, or about



Grading for a "Wye" at Cebu.

25 cents gold per day of 10 hours, with subsistence, while the capitaces receive one peso, or 50 cents. A scientifically proportioned diet of the most nourishing food is provided, costing the company about 25 centavos per day per man. This total cost of 75 centavos per day for common labor is high for the Philippines and was fixed only after much study of the experiences of the Government and others with Filipino labor. There were two vital considerations. The first was to fix a figure that would be considered fair by the Government and the Filipinos, thus enabling it to be maintained without disagreement throughout the period of construction. The second point was to determine the lowest figure that would attract the best working element among the natives in sufficient numbers to keep the large supervising organization fully occupied at all times.

Wages for common labor were found to vary widely in the archipelago, according to the supply and to the inclinations of employers. At the Marivales quarries in Luzon the rate was 90 centavos and subsistence. On the Toledo road construction in Cebu only 30 centavos with subsistence was paid for nine hours work. These were the extremes. In the former case the work was more arduous than that in prospect on the railroads, while in the latter it was much less so and was performed largely by boys and old men who would not do for railroad construction. From this it will be seen that the fixing of the wage scale was a delicate question, seriously involving the success of the enterprise. Then came the question of subsistence. Verified instances of men trying to live with too little nourishment in the effort to save money when paid entirely in cash with other considerations of organization determined the Chief Engineer to provide subsistence. The chief surgeon of the Philippine Railway Company, after due experiment, settled upon the proportions three-fifths rice, one-fifth beef, one-tenth fish, one-tenth vegetables and the remainder condiments, as the most nourishing composition for the daily diet of the native doing hard physical labor, and this standard was adopted. It may be noted that this ration, served in ample quantities, by a Chinese contract commissary, is much better calculated to forestall fatigue than anything to which the average of the men had hitherto been accustomed.

The fortunate outcome of this liberal policy measured by general results has been seen. A specific comparison of unit costs on the railroad up to date and on road making previously carried out in the Visayan islands, shows that the railroad company is getting from 50 to 60 per cent. more work for its money than has been returned before by native labor. An unprecedented stability of native labor forces has been attained. The working force does not vary from day to day, as has nearly always been the case heretofore, but the same men are to be found constantly on the work day in and day out, month by month, so that there is growing up for the first time in the Philippines that personal touch between the foremen and their men, which is so essential for efficient construction.

Fill No. 109, Island of Cebu; Philippine Railways.

In connection with wages, the problem of the method of payment was met by an interesting solution. The expense of maintaining a properly bonded staff of paymasters to pay men at short regular intervals would be heavy and besides there would be some physical difficulty connected with transporting by pack animals or cargadores, and handling large quantities of money, weighing something like 150 lbs. for every thousand dollars in the necessary small cash. Therefore the men are paid daily in time checks which are negotiable with certain leading merchants by special arrangement and with Ah Gong, the commissary. The plan works to the complete satisfaction of all but the disreputable characters who were accustomed to hover about the camps and mulct the laborers of their wages often as soon as they were paid. This undesirable condition has been almost entirely eliminated.

The benefits to the Philippine Islands of this use of native labor solely, as compared with the probable results if imported Chinese labor had been used, are many. Chinese labor would have assured the same first class railroad system at a total cost of possibly 5 per cent. less, but the economic gain to the country would probably have ended there. Cer-

A Side Hill Cut and Fill; Philippine Railways.

Grading at Mile 24, Island of Panay.

Clearing a Nipa Thicket; Philippine Railways.

tainly most of the money paid out as wages would have found its way to the Celestial Kingdom, while now it will be put in circulation in the islands to increase the money supply there. Furthermore, an industrial army of 20,000 men will have been trained in the principles of modern industry, and these men will naturally be absorbed except those who will be needed in operation, to very good advantage in the new industrial activity made possible by the railroads which they will have built.

It has now been shown how two of the three most vital considerations in the building of this railroad system have been met and substantially solved. To facilitate the working out of the standardization of equipment and rolling stock, there has been organized a so-called Technical Board, consisting of certain officers of J. G. White & Co. as the contractors, the Philippine Railway Company, two consulting engineers and the engineering executives in the field. This Technical Board co-operates with the Philippine Commission, for all decisions and purchases are subject to the approval of the latter body.

Nearly all the orders for the rolling stock, rails and materials thus far placed have been described from time to time in the *Railroad Gazette*. Some motive power in the shape of an early order of 50-ton mogul locomotives has been in use on construction for several months. Besides the regular ballast cars there have been in use on construction a large number of flat cars which will form part of the ultimate operating equipment. A considerable number of box cars have been shipped, and a small initial order of passenger rolling stock, 24 cars in all, has been placed.

The design of these passenger cars is not yet fully decided on and is one of the principal questions now before the Technical Board. Lacking a basis of actual experience under the exact conditions obtaining in the country where the cars will be operated, studies are being made of the passenger rolling stock, new and old, on several leading railroads in the tropics, notably the Sudan Government Military Railways, the Great Indian Peninsular Railway and Le Chemin de Fer du Congo. The design of the Philippine railroad passenger cars will be evolved from these studies modified by the judgment of the board as to the probable effect of conditions of operation in the Philippines which have no parallel elsewhere.

In the matter of materials a serious problem was to secure an adequate supply of timber suitable for ties, piles, etc. An order was

Finishing a Cut and Fill to Standard Width of 15 Feet.

placed for 150,000 ties of Jarrah, an Australian hard wood. It was feared that this supply would not be received rapidly enough to keep pace with the shipments of rails, and that the construction might be delayed. As was well-known to the Chief Engineer, some of the Philippine hard woods are eminently well adapted for the above purposes, but heretofore there has appeared to be no way to get the timber out. A special representative was sent down into the Island of Mindanao, remote from the scene of the railroads, to take up the question with the friendly Moro chiefs. Negotiations were successfully completed and hundreds of Moro tribesmen are at work in their own forests with their native knives and the saws supplied them, hewing trees and getting railroad ties out in finished shape. Indications are that this plan will naturally aid in solving the problem of timber supply.

Outlying Buildings of a Construction Camp.

A railroad is being planned to run from Hilo, on the eastern coast of Hawaii, northwesterly 45 miles. It will serve a number of sugar plantations in Hilo and Hamakua districts; at present the sugar is carried to the nearest point on the coast and loaded on

coastwise steamers instead of being shipped overland to a main port. The road will cost about $1,800,000. It is expected that it will eventually be built all the way around the island, going near the lower levels of Mauna Loa, which is an active volcano in the center of the island.

Pennsylvania Two-Cent Law Unconstitutional.

Judges Willson and Audenried, in Common Pleas Court, at Philadelphia last Tuesday, declared unconstitutional the two-cent fare law passed by the last Pennsylvania legislature. The case upon which the decision was made will be taken to the State Supreme Court at once, in the hope of getting a decision before October 1, when the law was to have gone into effect.

The Pennsylvania was the first to attack the law, bringing a suit in the Philadelphia courts to restrain the county of Philadelphia from collecting the fine for violating the provisions of the act, and it is on this suit that the decision is now given. Other railroads have brought similar proceedings in various counties of the state, but no decisions have been rendered, as it is generally understood that the Pennsylvania's suit will be made the test case in the higher court.

The decision of the court takes up 110 typewritten pages. After reviewing its limitations in the present case and declaring the "Pennsylvania Railroad Company is not vested with any immunity from the exercise of the power of the legislature to regulate rates," the court takes up the contention of the company that the two-cent rate is unreasonable, sustains the contention and grants the injunction asked for.

Continuing, the court says:

There remains now to be disposed of the question whether the act is to be denied enforcement on the ground that by reason of the generality of its language it extends to interstate commerce, and thus infringes on the province of the federal law. The question must be answered in the negative. A legislative intent to exceed constitutional rights and to violate fundamental law is never to be presumed if the language of the statute can be satisfied by a contrary construction. The act with which we are concerned is to be regarded as intended to apply only to that part of the passenger business of the railroads over which the legislative power of regulation extends, and since that business is not so confused with interstate passenger traffic as to be insusceptible of separate regulation we hold that the act is not invalid for the reason last suggested.

Upon the whole case we are of opinion, and therefore find, that, although with respect to its title and other matters of form no valid objection to the law exists, its operation, so far as it relates to the Pennsylvania Railroad Company, is objectionable on constitutional grounds for the following reasons:

As a regulation by the legislature of the rates of fares for passengers on the lines constructed by the plaintiff under the act of April 13, 1846, between Harrisburg and Pittsburg and Pittsburg and Erie, the act violates an existing contract between the plaintiff and the Commonwealth, and so contravenes Article I, Section 10, of the Constitution of the United States.

As a regulation of the plaintiff's intrastate passenger business in its entirety, the act under existing circumstances is unreasonable and confiscatory, and by depriving the plaintiff of its property without due process of law, violates Amendment 14 of the Constitution of the United States. * * *

Viewed as an alteration or revocation of the plaintiff's franchise, to establish * * * such rates as, within the maxima fixed by the second proviso of Section 21, of the act of April 13, 1846, its president and directors may deem reasonable, the act under consideration violates Article XVI, Section 10, of the constitution of Pennsylvania * * * by establishing so low a maximum rate of fare as to render that branch of the plaintiff's business unremunerative, but providing no compensation for the loss thereby occasioned.

We accordingly adjudge that the act of April 5, 1907, cannot be enforced so far as concerns the Pennsylvania Railroad Company, and that the county of Philadelphia should be restrained from demanding fines and attempting by action to collect them, if the maximum which that act attempts to establish be disregarded by the plaintiff.

Under the head of "plaintiffs' requests for findings of fact," the court affirms that:

The method used in ascertaining the expenses of handling the complainant's intrastate passenger business is the correct one.

That the percentage realized under existing rates of fare, upon the cost of the property, is not unfair or unreasonable, and that the percentage under the new law would not be fair or properly compensatory.

That cost of conducting railroad business for several years has been greatly and constantly increasing.

That a reduction in intrastate rates will most probably compel a corresponding reduction in interstate rates.

That the average rate per mile for carrying intrastate passengers does not now exceed two cents a mile.

That reduction of rates would not be likely to lead to increase of business.

That a uniform rate of two cents could not, in all probability, be obtained from all passengers, and is neither advantageous to the public nor just to the company.

That there is no evidence that the legislature investigated the matter before enacting the law.

In the defendant's requests for finding the court refuses the following:

In determining whether the maximum rate, as specified in the act, is improper, all the traffic and receipts of the plaintiff within the state, and subjected to the control of the legislature, must be taken into consideration. The passenger traffic cannot be segregated and considered without reference to receipts from the express and freight traffic and all other sources of corporate earnings.

The opinion of the court goes exhaustively into the many and intricate questions of law involved in the case. It is shown that, with the exception of the Philadelphia & Trenton Railroad and the Allegheny Valley Railroad, the leased lines of the Pennsylvania Railroad were vested with the same rights as to rates of toll and transportation charges as those conferred on the plaintiff company. While the Pennsylvania is operated under a charter granted under the old state constitution, nevertheless the company accepted the constitution of 1873, so that, as above stated, the company is not vested with any immunity from the exercise of the power of the legislature to regulate rates by virtue of grants thereof by the commonwealth to any of the corporations whose railroads it has leased or acquired.

The court states a large number of legal principles involved in the case, and cites decision affecting unreasonableness, confiscation, contract abrogation and the like, and declares that public service corporations in Pennsylvania are entitled to look for a rate of return, if their property will earn it, of not less than the legal rate of interest.

As to immunity from rate regulation on the line between Harrisburg and Pittsburg and any branch line to Erie constructed under the authority of the act of 1846, the court says that—

"The act of incorporation by which this immunity was conferred, being accepted by the plaintiff when it constructed its road on the faith thereof, constituted a contract between it and the commonwealth, whose obligation the latter could not impair. Neither the act of May 3, 1855, nor the constitutional amendment of 1857, nor the constitution of 1873 could have any such effect. * * * When the legislature alters or revokes a corporate franchise under Article 16, Section 10, of the constitution of 1873, it is necessarily implied that such franchise was, in its opinion, injurious to the citizens of the commonwealth. When the legislature, without providing for compensation, endeavors by general law to annul the charter right of a railroad company to establish its rates in accordance with a certain schedule and attempts an unreasonable regulation of its rates, this is a violation of the constitutional provision that no injustice shall be done to its corporators.

The court also considers the failure of the legislature properly to investigate passenger earnings and their proportion to freight business. This is discussed for the reason that the court was called upon to determine whether or not a two-cent maximum rate was a reasonable regulation so far as concerns the Pennsylvania Railroad. After analyzing the figures submitted during the trial of the suit, the court reaches the opinion that upon an actual investment of $32,548,802 of its own money, the Pennsylvania's probable earnings for 1907 for the passenger business within the state would yield a return of 5.1 per cent. on the basis of the rates charged at present. This would be less than legal interest.

"It is improbable that the doing away with commutation tickets and the exaction of a two cents per mile fare from those who have been using such tickets would serve to increase the net profits of the plaintiff, since, in all likelihood, such a change would so reduce the number of suburban riders and the amount of the higher rate business that such passengers incidentally bring to the company as to practically offset the increase of receipts due to the increase in fare."

The court does not agree with the county's contention that the freight business will not be affected by an increase in commutation rates, or that the passenger business is so combined with freight business as to be indistinguishable in the joint result. On the contrary, the opinion declares that experienced railroad men say that the business is readily distinguishable and further that "the legislature itself, in the very act now under discussion has, for the purposes of regulation, attempted to segregate the passenger traffic of the railways and to deal with it as if it existed as a thing apart from all else."

"If pushed to its logical result," says the opinion, "the argument advanced would justify a law requiring that the railroad companies of the state should carry all intrastate passengers without charge and look to their freight business for reimbursement of expenses and for a return on their investment in the business, which, of course, is the reductio ad absurdum."

GENERAL NEWS SECTION

NOTES.

The Missouri Pacific has made increases averaging 10 per cent. in the wages of 2,000 clerical employees.

The Texas State Railroad Commission has ordered the railroads to report train accidents promptly to the commission by telegraph.

In the Federal Court at Jamestown, N. Y., September 6, the Grand Jury returned indictments for illegal freight rates against the Standard Oil Co. and the New York Central and the Pennsylvania railroads.

The Mexican government has just released two Americans, railroad conductors, who have been in prison more than a year on the charge of murder, but who now are released unconditionally with no charges against them.

Officers of Mexican railroads are complaining that the Southern Pacific is devoting its freight cars to the needs of sugar cane traffic and other heavy business in Louisiana and Texas to the neglect of shipments destined for Mexico.

In the United States Court at Lincoln, Neb., September 10, the Burlington, the Northwestern and the Union Pacific obtained a temporary injunction to prevent the Nebraska State Railroad Commission from reducing freight rates on grain.

Commercial travelers of Chicago and west of there complain that the railroads in the West and Southwest have increased their extra baggage rates from 12½ per cent. of the passenger fare to 18 per cent.—an increase which evidently was made to offset the reductions which the state legislatures ordered in passenger fares.

The Southern Pacific has ordered the discontinuance of the sale of liquors on the trains of the company within the territory of Arizona, a law having been passed in that territory requiring the payment of a tax of $300 a year for each train in each county; and the Southern Pacific runs six trains a day through five counties.

Near Murdock, Neb., on the morning of September 6, the passengers in the chair car of an express train of the Rock Island road were robbed by three masked men with pistols who, until a moment before the robbery, had been riding peacefully in the car as passengers. The conductor endeavored to repulse the robbers, but their four "guns" were more than a match for his one.

The Pennsylvania Railroad has reported to the Department of Internal Affairs of the state of Pennsylvania that the line of its road from Philadelphia to Pittsburg is 348.9 miles long, or about five miles less than the distance hitherto shown in the company's timetables. The reporters are now figuring out how much the company has cheated the public annually in consequence of the use of this erroneous figure in computing passenger fares.

Between Milwaukee and Cedarburg, Wis., recently a length of 25,000 ft. of copper trolley wire was stolen from the line of the Milwaukee & Northern Electric Railway, all in a single night. The wire, weighing 500 lbs. per 1,000 ft., was all in place over the tracks, and the thieves must have had a "giraffe" wagon to enable them to commit the theft so quickly. The loss to the railroad company is about $3,000, and at last accounts there was no clew to the thieves.

According to the newspapers the use of Barclay's automatic printing telegraph on the lines of the Western Union Telegraph Company has been much extended since the strike. This apparatus which, at the receiving station, prints telegrams on the regular blank, like any other typewriter, is in use on lines between New York and Boston, New York and Philadelphia, New York and Pittsburg, New York and Boston and New York and St. Louis. It was described in the *Railroad Gazette* of June 9, 1905.

The Secretary of State of Missouri has been enjoined by Judge Pollock, of the United States Court, at St. Joseph from annulling the Chicago, Rock Island & Pacific Railway's charter for its refusal to stop its through trains at Lathrop, a junction with the Atchison, Topeka & Santa Fe, for which the Rock Island was fined in the state courts and appealed to the Federal court, thus ignoring the statute prohibiting corporations doing business in Missouri from appealing from state to Federal courts. The hearing will be held next Monday.

President A. B. Stickney, of the Chicago Great Western Railroad, in an affidavit filed in the Federal court at St. Paul last Monday, says that if the commodity and the 2-cent passenger rates, now in controversy in Minnesota become effective his road will be financially ruined. It will suffer a reduction of 22 per cent. on fine grains, 28 per cent. on corn, more than 42 per cent. on hard coal and nearly 26 per cent. on soft coal. The company accepted the freight tariff promulgated by the State Railroad Commission in 1906, though by so doing it sustained a loss in revenue of 22 per cent. It was hoped to make up this loss in increased traffic, but this hope was not fully realized.

At Milwaukee it is reported that the principal railroads of Wisconsin are considering the complete abolition of commutation tickets. Under the law of that state, which now forbids discrimination with minute particularity, every town to or from which desired commutation tickets are not sold is expected to complain of the discrimination practiced by the railroads in favor of other towns at which commutation privileges are granted. It is also reported in Milwaukee that the sale of local single-trip tickets has increased on many of the roads to a marked degree since the reduction of all fares to 2 cents a mile. This increase of traffic has been particularly noticeable on Sundays, and numerous bits of circumstantial evidence are cited to support the statement made.

Controlled Manual on the Burlington.

The Chicago, Burlington & Quincy is preparing to install on its line from Aurora to Savannah, Ill., the manual block system arranged for the use of the single-track control apparatus which is made by the General Railway Signal Company, of the type which has been in use for the last few years on several hundred miles of the single-track lines of the Illinois Central. The officers of the Burlington expect to rapidly extend the use of controlled manual signals over about 2,000 miles of their single-track lines.

Cautiousness Extraordinary.

The Standard Oil Company shies when a railroad company tenders money to its officers! When the western lines made interstate fares 2 cents a mile the mileage credential was no longer necessary, and notice was given that such credentials would be redeemed by the Western Passenger Association at their face value. The Standard Oil Company returned 187 which had been in use by its representatives. In due time the Association sent the company a check for $1,776.50, but the check was returned. The legal department wrote to the General Passenger agents of the various lines asking for copies of the circular announcing the redemption, and if such circular had been regularly filed with the commission, and if the action had official cognizance. In the meantime, the mileage bureau is holding the check.—*Exchange.*

Disastrous Derailment at Norris, Iowa.

Twelve persons were killed and about the same number injured at Norris, Iowa, on September 6, when a northbound passenger train of the Chicago, Rock Island & Pacific was derailed at or near the station while running at full speed. The derailment occurred just at the moment that the engine of the passenger train passed the engine of a freight which was standing on the side track, and the engine and first three cars of the passenger train were thrown with great violence against the freight engine. All of the passengers killed or injured were in the smoking car, which appears to have been the third from the engine.

Six Passengers Killed at Caledon, Ont.

In the derailment of a special passenger train, heavily loaded, on the Canadian Pacific near Caledon, Ont., about 40 miles west of Toronto April 3, six passengers were killed and a large number were injured. The train was traveling on a steep descending grade around a sharp curve and appears to have been thrown off the track by excessive speed. The engineman is 23 years old and he had made but two trips before this in charge of a passenger train. The speed at which the train was traveling as it approached the curve was so high that an experienced track foreman, who was at work on the track, warned his gang of men to leap over the fence to safeguard their lives, the foreman feeling sure that the speed, which was about 35 miles an hour, was too high for the curve.

Chicago Railways Company Not in Possession.

The order recently entered by Judge Grosscup in the United States Circuit Court directing the receivers of the Union Traction Company, which operates the street car system on the north and west sides of Chicago, to turn these properties over to a new corporation called the Chicago Railways Company for 20 years, has been reversed by the United States Court of Appeals. The decision of the higher court remands the case to the United States Circuit Court and leaves the situation where it was before the formation of the Chicago Railways Company.

The Court of Appeals said that Judge Grosscup had no power to give possession to the Chicago Railways Company without the

consent of the bondholders and stockholders of the underlying companies, and that the only manner in which the railways company could obtain possession of the traction properties was through negotiations with the stockholders and the bondholders.

The action of the Court of Appeals hinged entirely on the question of jurisdiction. The power of Judge Grosscup to issue the order in favor of the Chicago Railways Company was the only thing assailed. The opinion, by Judge Brewer, of the United States Supreme Court, praised the wisdom of the order, but declared that legally it was wrong.

The Noise Nuisance on Street Cars.

Blowing of whistles by conductors of South Side street railway cars as signals for stopping and starting must stop.. The ear-splitting communication between the conductor and motorman was dispensed with yesterday by order of the President. In days past the conductor took delight in blowing his whistle as close as possible to the passenger's ear, the more inoffensive the passenger the louder the signal. President Mitten says that "the car whistle is a relic of barbarism and of the cable epoch now consigned to students of geology. In the future conductors will rely on the bell cord, which does not interfere with the comfort of passengers." The conductor's blasts have been mistaken for the notifications of the policemen at crossings, and now even the use of the whistle to warn teamsters out of the track is forbidden.—*Chicago Record-Herald.*

The American Locomotive Company.

In the last fiscal year the American Locomotive Company did the largest amount of business since its organization six years ago. It built new shop buildings and power plants and installed machinery and equipment at its different works, particularly at Schenectady, Dunkirk, Richmond and Montreal; these improvements cost $1,692,859, and were paid for out of the extraordinary additions and betterment fund of $2,000,000 created last year. An equal amount has been set aside to carry on similar work next year. During the past year, $5,000,000 5 per cent. notes, maturing in five equal annual instalments from October 1, 1907, to October 1, 1911, were issued to provide working capital. Last spring the structural steel department at Montreal was sold to the Structural Steel Company, Ltd., and the Locomotive & Machine Company of Montreal will hereafter build only locomotives, steam shovels and rotary snow plows. In the following statement of earnings, income from investments, etc., is included in gross earnings.

	1907.		Changes.
Gross earnings	$49,515,486	Inc.	$6,967,610
Expenses	42,744,381	"	6,659,011
Net earnings	$6,771,105	Inc.	$308,599
Fixed chrgs., bills payable, &c.	412,898	"	131,086
Available for dividends	$6,358,207	Inc.	$177,513
Div. on preferred, 7 per cent.	1,750,000	.....	.....
Div. on common, 5 per cent...	1,250,000	Inc.	937,500
Surplus after dividends	$3,358,207	Dec.	759,987
Extra. addtns and betrmt fund	2,000,000	.....	.....
Surplus	$1,358,207	Inc.	$241,578

Progress on Panama Canal.

The excavation of the Panama canal is now one-tenth completed. The work done in August, despite the heavy rainfall of 11.89 in., amounted to 215,625 cu. yds. more than was done in July, and surpassed all previous records.

The total amount of material to be excavated was estimated in June, 1904, to be 111,280,000 cu. yds. Since then and up to August 31, an aggregate of 10,863,684 yds. had been excavated. There are now sixty-three steam shovels at work and 34 will soon be received. The present force in constant employment on the isthmus consists of 30,500 men. Reports from the isthmus show that the health records are better than in most of the larger cities of the United States.

President Johnson on Restrictive Legislation.

From the advance sheets of the Norfolk & Western annual report we take the following comment by President Johnson on the legislative situation:

The rapidly progressing development of the coal areas tributary to your lines makes it increasingly evident that the demands upon your management for transportation cannot be properly met without the complete double tracking of the line from Concord to Columbus. This work, while important to the interest of the stockholders, is equally important to the welfare of the commonwealths traversed by your lines and to the property of their citizens who are striving to develop the natural wealth of their states and to broaden the market for their mineral and other products.

It therefore goes without saying that any policy which hampers the development of railroads, or by depleting their revenues lowers their credit and thus repels investors who would otherwise purchase their securities at fair prices, cannot but be fraught with disaster both to the states and to the railroads. It is not believed that such a policy will commend itself to the dispassionate judgment of the communities served by your lines, or that in the effort to correct abuses that may exist unjust treatment will be accorded to corporations that are honestly endeavoring to fulfil the purposes for which they were chartered.

It is only 11 years since your railroad passed through a receivership and foreclosure and a drastic reorganization, and it certainly cannot be seriously claimed that the small dividends since paid to the shareholders have yielded even a just return upon its capital. The owners of your property are entitled to the same good faith which is properly exacted from them, and no temporary prejudices or misunderstandings can excuse or justify action which would deprive a railroad shareholder of the rights and remedies which are guaranteed to all classes of the community.

Fire Protection in Altoona Yards.

The Pennsylvania Railroad is to put fire extinguishing apparatus on all of the 26 locomotives used in the freight yards at Altoona, Pa., and most of these engines are already equipped. This action is a result of the determination on the part of the company to provide, without reference to the city fire department, for a complete fire-fighting system in its yards. The Altoona yard is divided into five fire districts, each with an alarm whistle.

In the Pittsburg yards the fire organization, which is also to be adopted at Altoona, is as follows: The conductor of the crew is the "foreman," and is the man to direct the work of a crew when called to answer a fire alarm. The flagman is designated as the "hoseman," it being his duty to see that the hose is removed from the reel and coupled to the water attachment as promptly as possible. The two brakemen of the crew are designated as "nozzlemen." Weekly tests are made to promote efficiency.

Foundry Cooling.

A letter from the Bellevue Pipe & Foundry Co. to the American Blower Co., Detroit, Mich., says that in order to keep the foundry cool enough to work in during the hot summer days the steam coils of the hot-blast heating system were filled with cold water and the fan run as for heating. The experiment was a success and as a result not a day was lost in the moulding room. The American Blower Co. has given special attention to the matter of proper heating and ventilation of foundries by a system which makes it possible to cool and ventilate with equal satisfaction in the summer time, and thus save much lost time as well as maintain the efficiency of the plant while in operation.

Railroad Y. M. C. A. at Baltimore.

The Baltimore & Ohio Railroad Company has awarded a contract for the erection of a new Y. M. C. A. building at Riverside, Baltimore, to J. J. Walsh & Sons, of that city. The building will cost about $33,000 and it is to be ready for use March 1. It will be of brick, 36 ft. x 100 ft., two stories high, with attic and basement. On the first floor will be a reception hall, game room and reading room, and on the second the assembly room, one class room, four bedrooms, ladies' retiring room, buffet, kitchen and two toilet rooms. The attic will be taken up by one large dormitory. New association buildings have been built at Brunswick, Cumberland, South Chicago, Newark, Holloway and several other places, and it is contemplated to still build others.

The Dramatis Personae.

A prominent railroad man, in close touch with the southern roads, gives the following partial explanation of recent occurrences:

The zone of the Southern states in which the antagonism between the state and the railroads has become most acute has been in North Carolina, Georgia and Alabama. These three states are represented, respectively, by Gov. Robert B. Glenn, Gov. Hoke Smith and Gov. Comer. Gov. Glenn was formerly a Southern Railway attorney, Gov. Smith made his money chiefly by prosecution of damage suits against railroads, and Gov. Comer is a farmer. Gov. Glenn is opposed in North Carolina by a United States Circuit Judge, Peter C. Pritchard. Gov. Comer is opposed in Alabama by United States Judge Thomas G. Jones. Gov. Smith is "layin' low and sayin' nuthin'."

Gov. Smith says that he has a scheme that will outscheme the Governors of North Carolina and Alabama in their bids for the Democratic nomination for the Presidency, though he has given no intimation as yet as to the details of his plan. Hoke Smith's father was born in Vermont, and he has no war record; Gov. Glenn's father was killed in the Confederate Army; Judge Thomas G. Jones was wounded several times in defence of Alabama as a Confederate soldier; the father of Judge Pritchard was killed on account of his Union predilections, together with other East Tennesseans in the beginning of the civil war; Gov. Comer took no part in the war.

The Southern Railway, both in Alabama and North Carolina, capitulated to the state authorities, but the Louisville & Nashville has not done so. The L. & N. is managed by one of the most dominating and commanding railroad spirits in the United States, Milton H. Smith, who defies and hates Comer and will take advantage of every right that he has under the Federal law.—*New York Times.*

"Courteous* and Absolutely Equal Treatment."

General Manager E. A. Handy, of the Lake Shore & Michigan Southern and its controlled lines, has issued to employees of the operating department a circular in which he says:

The following outlines in a general way the relations which the management desires to see established between its employees and the public. They are presented for your individual guidance and observance.

The public judges a railroad corporation very largely by the treatment it is accorded by the agent representing the company, in whatever capacity he may be employed.

A reputation for fair dealing, with courteous and absolutely equal treatment of all customers, is as essential to the success of the railroad as it is to the success of any other business.

The interest of the farmer, the manufacturer, the mine owner, the merchant and the railroad is mutual, and efficient transportation facilities are necessary to the success of all.

The good will and friendship of the communities served by our companies is the most valuable asset they can have; and the strongest recommendation for promotion an employee in any department can possibly have is the fact that by uniform courtesy and kindly accommodation of patrons he has secured for himself and for the road the good will and friendship of the community in which he is located.

We earnestly ask our employees to be governed by the above, in spirit as well as in letter.

MANUFACTURING AND BUSINESS.

The Atlantic, Quebec & Western will soon be in the market for ties to be used on its line now building from Port Daniel, Que., to Gaspe Basin, 80 miles.

V. I. Smart, Signal Engineer of the Chicago & Eastern Illinois, has been appointed Assistant Professor of Transportation at McGill University, Montreal, Can.

K. W. Blackwell has resigned as Managing Director of the Montreal Steel Works, Montreal, Can., but remains President. W. F. Angus, Secretary, has been appointed General Manager.

A. L. Whipple, who has been Eastern Representative of the Curtain Supply Co., Chicago, since the formation of that company, has been appointed Eastern Manager, with headquarters at the New York office, Park Row building, New York city.

The contracting office of the Virginia Bridge & Iron Company, Roanoke. Va., heretofore at Little Rock, Ark., has been transferred to New Orleans, La. The office will be in charge of F. E. Golian, C. E., of the Atlanta office, who has been with the company for some time.

Lewis O. Cameron, of Atlanta, Ga., Manager of Sales in the Southern district of the Pressed Steel Car Company, New York, was married on September 4 at Calvary Episcopal Church, New York, to Miss Louise Wann, of that city. The bride is the daughter of Mr. and Mrs. Charles Wann, of New York, and niece of F. A. Wann, General Traffic Manager of the San Pedro, Los Angeles & Salt Lake.

Iron and Steel.

The Kanawha & Michigan has ordered 3,000 tons of rails.

The Toledo & Ohio Central has ordered 4,000 tons of rails.

The Hocking Valley has given an order for 5,000 tons of rails.

The Erie will shortly give a contract for 1,100 tons of bridge steel.

The American Steel & Wire Company has announced an advance of $1 a ton on its wire products.

The New York Central is receiving bids for an additional 2,000 tons of steel to be used on its New York terminal.

The Atlantic, Quebec & Western will soon be in the market for rails, to be used on 80 miles of line now under construction.

The McClintic-Marshall Construction Company has received an order for 3,000 tons of structural steel for the new open hearth works of the Pittsburgh Steel Company.

OBITUARY NOTICES.

A memorial of Samuel Spencer, late President of the Southern, has been published. It consists of a minute adopted by the Voting Trustees and the Board of Directors of the company in joint meeting shortly after Mr. Spencer's death, which occurred on November 29, 1906. It is a testimonial to his character and attainments and rehearses his work in connection with the growth of the railroad company of which he was the first President.

*Courteous: Showing well-bred consideration; affable—*Dictionary.*

ELECTIONS AND APPOINTMENTS.

Executive, Financial and Legal Officers.

Apalachicola Northern.—E. A. Faulhaber, St. Louis, Mo., has been appointed Receiver.

Chicago Junction.—H. E. Poronto, Purchasing Agent, has been elected also Secretary. R. B. Thomson, Assistant Treasurer, has been elected Treasurer.

Colorado Southern, New Orleans & Pacific.—J. H. Elliott, General Superintendent of the Third district of the St. Louis & San Francisco, has been elected Vice-President and General Manager of the Colorado Southern, New Orleans & Pacific, with office at Beaumont, Tex.

Mexican Central.—E. W. Cartlidge, Assistant to the Vice-President at Boston, Mass., has been appointed Assistant to the Vice-President at Mexico City, Mex.

Missouri & Louisiana.—Charles S. Keith, Vice-President and General Manager, has been elected President. John A. Sargent, Traffic Manager and General Superintendent, succeeds Mr. Keith.

Raritan River.—G. C. Chittick has been appointed Auditor, with office at South Amboy, N. J.

St. Joseph & Grand Island.—W. N. Purvis has been elected Secretary, with office at St. Joseph, Mo., succeeding F. W. Russell. W. M. Mooney has been appointed Acting Auditor, with office at St. Joseph, succeeding to the duties of F. C. Uhlman, who went to the Virginian Railway.

Tehuantepec National.—H. W. Morris, Assistant to the Vice-President, has been assigned to other duties and his former position has been abolished.

Tonopah & Tidewater.—B. W. Fernald has been appointed Auditor, with office at Los Angeles, Cal.

Operating Officers.

Baltimore & Ohio Southwestern.—James Donahue, Trainmaster of the Springfield division, has been appointed Trainmaster of the Indiana division, with headquarters at Seymour, Ind., succeeding E. G. Owens, resigned to go into other business.

Canadian Pacific.—A. Stevens, chief train despatcher at Vancouver, B. C., has been appointed Superintendent at Winnipeg, Man., succeeding J. T. Arundel, transferred.

Chicago, Rock Island & Pacific.—The headquarters of J. C. Nolan, Superintendent of the Louisiana division, have been moved from Ruston, La., to El Dorado, Ark.

Colorado & Southern.—H. E. Renick, Trainmaster at Denver, Colo., has been appointed Assistant Superintendent of the Fort Collins, Clear Creek and Pueblo districts, with office at Denver.

Erie.—The offices of C. C. Riley, Superintendent of Transportation, and G. W. Kirtley, Assistant Superintendent of Transportation, have been moved from Jersey City, N. J., to New York.

Fitzgerald, Ocilla & Broxton.—M. W. Gant has been appointed Trainmaster, with office at Fitzgerald, Ga.

Georgia, Florida & Alabama.—W. R. Parsons has been appointed Trainmaster at Bainbridge, Ga., succeeding to the duties of D. L. Turner, Jr., Acting Trainmaster.

Kalamazoo, Lake Shore & Chicago.—James Grant, Secretary, has been appointed General Superintendent, with office at South Haven, Mich., succeeding Blaine Gavett, resigned to go to another company.

Missouri Pacific.—See St. Louis & San Francisco.

Missouri Southern.—J. T. Fredricks has been appointed General Manager, with office at Leeper, Mo., succeeding P. R. Walsh, resigned. H. A. Radtke has been appointed Superintendent, with office at Leeper, Mo., succeeding C. M. Phelps.

Northwestern Pacific.—W. S. Palmer, General Superintendent of the Northern district of the Pacific system of the Southern Pacific, has been appointed General Manager of the Northwestern Pacific, succeeding James Agler, resigned.

Panama.—J. A. Smith has been appointed General Manager, succeeding W. D. Bierd.

Paris & Great Northern.—W. H. Upton has been appointed General Superintendent, with office at Paris, Tex., succeeding E. W. Dickson.

St. Louis & San Francisco.—J. A. Frates, Trainmaster at Springfield,

Mo., has been appointed General Superintendent of the Third district, with office at Chaffee, Mo., succeeding J. H. Elliott. J. G. Lorton, Superintendent of the Valley division of the Missouri Pacific, has been appointed Superintendent of the Northern division of the St. Louis & San Francisco, succeeding J. E. Hutchison, promoted. See Colorado Southern, New Orleans & Pacific, under Executive, Financial and Legal Officers.

Southern Pacific.—W. R. Scott, Superintendent of the Western division, has been appointed General Superintendent of the Northern district of the Pacific system, with office at San Francisco, Cal., succeeding W. S. Palmer, resigned to go to the Northwestern Pacific. J. H. Young, formerly General Superintendent of the First district of the St. Louis & San Francisco, succeeds Mr. Scott, with office at Oakland Pier, Cal. See Northwestern Pacific.

Tehuantepec National.—W. N. Cartwright, Superintendent of Transportation, has been appointed Superintendent, with office at Rincon Antonio. J. H. Sayers has been appointed Terminal Superintendent at Coatzacoalcos, V. C., succeeding J. J. Lewis, resigned.

Traffic Officers.

Chicago, Indianapolis & Louisville.—The office of Traffic Manager, held by the late Charles H. Rockwell, has been abolished. B. E. Taylor has been appointed General Freight Agent, succeeding O. C. Carter.

Louisville & Nashville.—W. A. Russell, Assistant General Passenger Agent, has been appointed General Passenger Agent, succeeding C. L. Stone, who is now Passenger Traffic Manager of the Missouri Pacific.

Engineering and Rolling Stock Officers.

Baltimore & Ohio.—Lucius T. Gibbs has been appointed Electrical Engineer, succeeding W. D. Young, resigned.

T. H. Russum, supervisor car department, has been appointed to the new office of Superintendent of the Passenger Car Department and his former office has been abolished. J. J. Tatum, general foreman car department at Mt. Clare, Baltimore, Md., has been appointed to the new office of Superintendent of the Freight Car Department. The offices of both are at Baltimore, Md. J. F. Bowden, general foreman locomotive department at Trinidad, D. C., has been appointed Master Mechanic at Parkersburg, W. Va., succeeding J. P. Dorsey, resigned.

Chicago & Eastern Illinois.—V. I. Smart, Signal Engineer, has resigned. L. C. Hartley, Assistant Engineer of the Pittsburg, Cincinnati & St. Louis at Logansport, Ind., succeeds Mr. Smart.

Chicago & North-Western.—John Charlton, foreman of shops at Antigo, Wis., has been appointed Master Mechanic of Chicago terminals, succeeding L. M. Carlton, resigned.

Erie.—Charles James, Master Mechanic at Galion, Ohio, has been appointed Master Mechanic at Port Jervis, N. Y., succeeding G. A. Moriarty, resigned to go to another company. E. S. Fitzsimmons, general foreman boiler maker, succeeds Mr. James.

Missouri Pacific.—W. L. Calvert, Master Mechanic of the Valley division, with office at McGehee, Ark., has been appointed to the new office of Master Mechanic of the White River and Memphis divisions, with office at Carter, Ark. J. T. Johns succeeds Mr. Calvert. W. A. Bedell has been appointed Master Mechanic at Van Buren, Ark., succeeding B. Donahue, resigned. The White River and Memphis divisions were formerly under the authority of the Master Mechanic at Van Buren.

Oregon Short Line.—C. C. Stroufe has been appointed Assistant to the Chief Engineer, with office at Portland, Ore.

Pennsylvania Lines West.—See Chicago & Eastern Illinois.

Purchasing Agents.

Northern Pacific.—L. Crassweller, Assistant Purchasing Agent, has been appointed Purchasing Agent at Tacoma, Wash.

LOCOMOTIVE BUILDING.

The Bessemer & Lake Erie, it is said, has ordered 21 locomotives.

The Tehuantepec National is said to be in the market for locomotives.

The Jamaica Government Railway is said to have ordered two locomotives.

The Atchison, Topeka & Santa Fe denies having ordered a number of 16-wheel Mallet compounds, as reported in the *Railroad Gazette* of August 16. This type of locomotive will not be used by the road for some time to come.

The Grand Rapids & Indiana has ordered four simple consolidation (2-8-0) locomotives from the American Locomotive Co., for January, 1908, delivery.

General Dimensions.

Type of locomotive	Consolidation
Weight, total	178,000 lbs.
Weight on drivers	152,000 "
Diameter of drivers	56 in.
Cylinders	21 in. x 28 in.
Boiler, type	Belpaire wide firebox
" working steam pressure	200 lbs.
" number of tubes	314
" material of tubes	Charcoal iron
" diameter of tubes	2 in.
" length of tubes	174 "
Firebox, length	102 "
" width	62¼ "
" grate area	44.5 sq. ft.
Heating surface, total	2,530.0 "
Tank capacity	6,000 gals.
Coal capacity	24,000 lbs.

Special Equipment.

Air-brakes	Westinghouse
Bell ringer	"Little Giant"
Boiler lagging	Keasbey & Mattison
Brake-beams	Greco
Couplers	Kelso and Pitt
Headlights	Star
Injector	Nathan
Piston rod packings	Grand Rapids & Indiana
Valve rod packings	Grand Rapids & Indiana
Safety valve	Kunkle
Sanding devices	Leach
Sight-feed lubricators	Nathan
Springs	Railway Steel-Spring Co.
Steam gages	Ashton
Steam-heat equipment	Grand Rapids & Indiana
Tires—tender wheel	Schoen

The Butte, Anaconda & Pacific, as reported in the *Railroad Gazette* of August 2, has ordered four simple consolidation (2-8-0) locomotives from the American Locomotive Co., for November delivery.

General Dimensions.

Type of locomotive	Consolidation
Weight, total	185,000 lbs.
Weight on drivers	167,000 "
Diameter of drivers	52 in.
Cylinders	21 in. x 28 "
Boiler, type	Straight top
" working steam pressure	200 lbs.
" number of tubes	370
" maker of tubes	Shelby
" diameter of tubes	2 in.
" length of tubes	12 ft. 10 "
Firebox, length	108 "
" width	60 "
" material	American Locomotive Co.'s standard
" grate area	45 sq. ft.
Heating surface, total	2,646 "
Tank capacity	6,000 gals.
Coal capacity	12 tons

Special Equipment.

Air-brakes	Westinghouse
Axles	Cambria steel; Coffin process
Bell ringer	"Little Giant"
Boiler lagging	Keasbey & Mattison
Brake-beams	Standard Steel Car Co.
Brake-shoes	American Brake-Shoe & Foundry Co., steel back
Couplers	Major
Headlights	Dressel
Injector	Ohio
Journal bearings	Ajax metal
Piston-rod packings	Jerome
Valve-rod packings	Jerome
Safety valve	Ashcroft
Sanding device	Leach
Sight-feed lubricators	Detroit
Springs	Railway Steel-Spring Co.
Steam gages	Ashcroft
Tires—driving wheel	Latrobe
Tires—truck wheel	Latrobe
Tires—tender wheel	Griffin

CAR BUILDING.

The Tehuantepec National is said to be in the market for cars.

The Utah Light & Railway Company, Salt Lake City, is said to have ordered 50 cars.

The Eldorado & Wesson has ordered one coach from the Hicks Locomotive & Car Works.

The Beaumont & Great Northern has ordered one coach from the Hicks Locomotive & Car Works.

The American Steel & Wire Company, Chicago, as reported in the *Railroad Gazette* of August 30, has ordered 25 cars.

The Stephenville, North & South Texas, Stephenville, Tex., has ordered 20 box cars of 60,000 lbs. capacity from the American Car & Foundry Co., one first-class coach from the Hicks Locomotive & Car Works, and one combination caboose from the Handlan-Buck Manufacturing Co.

The Chicago & Illinois Midland has ordered six flat cars, three of 80,000 lbs. capacity and three of 60,000 lbs. capacity, from the Hicks Locomotive & Car Works. These cars will be 41 ft. and 36 ft. long, 8 ft. 11 in. and 8 ft. 9 in. wide, over all. The special equipment includes:

Brake beams	Simplex
Brakes	Westinghouse
Couplers	Tower
Draft rigging	Harrison twin spring and Miner tandem
Paint	Hicks standard

The Atchison, Topeka & Santa Fe, as reported in the *Railroad Gazette* of August 23, has ordered 10 wooden 70-ft. steel underframe combination automobile and horse cars from the American Car &

Foundry Company for November delivery. The special equipment includes:

Brake-beams	Chicago Railway Equipment Co.
Brake-shoes	Perfecto
Brakes	Westinghouse
Brasses	Hewitt
Couplers	Janney
Draft rigging	Miner
Dust guards	Soule
Journal boxes	Franklin
Springs	Simplex Railway Appliances

The Union Pacific, as reported in the *Railroad Gazette* of August 9, is building 25 all-steel box cars of 100,000 lbs. capacity at its Omaha shops. These cars will weigh 37,400 lbs., and will measure 40 ft. long, 8 ft. 10⅛ in. wide and 7 ft. 11 in. high, inside measurements. The special equipment includes:

Bolsters, truck	Buckeye
Brake-beams	Waycott
Brake-shoes	Congdon steel back
Couplers	Climax
Door fastenings	National safety
Doors	Security
Draft rigging	Sessions
Journal boxes	National Malleable Castings Co.
Trucks	Andrews cast-steel side frame
Wheels	Davis cast steel

RAILROAD STRUCTURES.

BUFFALO, N. Y.—The Delaware, Lackawanna & Western, it is said, is building a reservoir to have a capacity of 25,000,000 gallons, to supply water for the company's engines, also for its East Buffalo shops. The reservoir is to cover an area of 15 acres.

DUNSMUIR, CAL.—The shops of the Southern Pacific at this place are to be enlarged, by an addition 100 ft. long, and six stalls are to be added to the roundhouse. The company also proposes to put up shops about 1,000 ft. long at Chestnut, one mile south of Dunsmuir.

NEW WESTMINSTER, B. C.—The Great Northern has submitted plans for a proposed station to be built at this place.

NEW YORK, N. Y.—The bids recently opened for the construction of the Queens approach for the Blackwell's Island bridge were: Maryland Steel Company, $758,600; Buckley Realty Construction Company, $797,804; Williams Engineering & Contracting Company, $809,345, and the Richard Henningham Company, $914,170.

PORTAGE LA PRAIRIE, MAN.—For some time negotiations have been in progress between the Grand Trunk Pacific and residents of this place to build a joint traffic and railroad bridge over the river here.

PORT DANIEL, QUE.—Bids will soon be asked for by the Atlantic, Quebec & Western for bridges to be built on its line between this place and Gaspe Basin.

SACRAMENTO, CAL.—The Northern Electric Company will build a large highway bridge over the Sacramento river.

RAILROAD CONSTRUCTION.

New Incorporations, Surveys, Etc.

APALACHICOLA NORTHERN.—This road is now open for traffic from River Junction, Fla., to Apalachicola, 80 miles.

ATCHISON, TOPEKA & SANTA FE.—Contract is reported let by this company to Ransom & Cook for grading its new yards at Chanute, Kan. Work is also to be started by Harvey Stuyvers on a new roundhouse and shop buildings.

BUFFALO, ROCHESTER & PITTSBURGH.—This company, it is said, is getting estimates for double-tracking its main line from Butler, Pa., northeast to Punxsutawney, 62 miles.

BULLFROG-GOLDFIELD.—See Tonopah & Goldfield.

CANADIAN NORTHERN QUEBEC.—Construction work on the Montfort branch has been finished and the line is now open for freight traffic between St. Jerome and St. Sauveur.

CANADIAN PACIFIC.—Contracts are reported let by this company to McDonell & Czowski, of Vancouver, B. C., for improving the main line grades around Field, B. C. The work involves cutting two tunnels aggregating about a mile and a half, one on each side of the Kicking Horse river, and putting up two bridges. The cost of the work, it is said, will be about $1,500,000, and it will take about a year and a half to finish it. (May 24, p. 727.)

CACHE VALLEY.—This road, which runs from Sedgwick, Ark., to Light, in Green county, has been sold to a syndicate of which J. D. Goldman of St. Louis is President, A. Bertig of Paragould, Vice-President; H. A. Culver, Second Vice-President; S. C. Dowell, Treasurer, and G. W. L. Brown, General Manager, all of Walnut Ridge. The new owners propose to extend the north end of the line from Light east to Paragould, 28 miles, and the south end northeast to Walnut Ridge, 10 miles, or southwest to Newport, 40 miles. (March 15, p. 380.)

CENTRAL OF GEORGIA.—This company, it is said, has stopped work on improvements which were to cost about $2,000,000 because of the reduction of rates ordered by the Georgia Railroad Commission.

CHICAGO & NORTH-WESTERN.—The extension from Gregory, S. Dak., to Dallas, 3.6 miles, has been finished and trains are now run from Bonesteel through to Dallas.

On the Ashland division the line from Antigo, Wis., to Bryant, has been extended northwest to Van Ostrand, 17.4 miles.

This company has started proceedings in the Superior Court to condemn 97 parcels of land in Chicago near the site of its proposed new terminal station.

DENVER & GULF.—This company has increased its capital stock from $2,000,000 to $10,000,000. The company was chartered this spring to build from Denver, Colo., southeast to Snyder, Okla., 500 miles. (May 10, p. 663.)

FLINT RIVER & GULF.—See Gulf Line.

GRAY'S POINT TERMINAL.—See St. Louis Southwestern.

GREAT NORTHERN.—On the Minot division a new line called the Crosby line, has been opened for business from Berthold, N. Dak., northwest to Lignite, 55 miles.

GULF LINE.—Under this name the Flint River & Gulf, operating from Hawkinsville, Ga., southwest to Bridgeboro, 77 miles, has been taken over by this new company. The lease of the Hawkinsville & Florida Southern, which owns the first 44 miles from Hawkinsville south, is also taken over. An extension is projected from Bridgeboro southwest to Bainbridge, 60 miles.

HAWKINSVILLE & FLORIDA SOUTHERN.—See Gulf Line.

INTERCOLONIAL.—The Intercolonial is reported double-tracking its Point du Chene branch from Moncton, N. B., to Painsec Junction, eight miles. The cost of the improvements will be about $300,000.

LAKE SHORE & MICHIGAN SOUTHERN.—A contract for grading is reported let to M. C. Connors, of Appleton, Wis., at $45,000. The amount of material to be removed is estimated at 280,000 yds. and the work is to be finished by December.

LARIMER & ROUTT COUNTY.—New Hampshire and Massachusetts capitalists have organized this company, with a capital of $1,000,000, to build a line from a point on the proposed extension of the Larimer, Hahn's Peak & Pacific, at the Colorado-Wyoming state line south into North Park, terminating near the mouth of Grizzly creek, Colo.

MINNEAPOLIS & ST. LOUIS.—The Missouri river division, built under the name of the Minnesota, Dakota & Pacific, has been opened for business from Conde, S. Dak., west to Lebeau, 115 miles. (Aug. 23, p. 215.)

MINNESOTA, DAKOTA & PACIFIC.—See Minneapolis & St. Louis.

MORGANTOWN & KINGWOOD.—This road has been extended and is now in operation from Kingwood, W. Va., south to Rowlesburg, 18 miles. (July 12, p. 53.)

OHIO RIVER & NORTHERN.—Work, it is said, has begun on this line, projected from Midland, Pa., down the Ohio valley to Wellsville, thence north to Lisbon, Ohio, where connection is to be made with the Lake Erie & Western. All the right of way has been secured. The project is backed by P. F. Smith and W. P. DeArmitt, steel and coal men of Pittsburg, and other eastern and Ohio capitalists. J. L. Francis, of Chicago, is also interested.

OPELOUSAS, GULF & NORTHEASTERN.—See Texas & Pacific.

ST. LOUIS SOUTHWESTERN.—The Gray's Point (Missouri) Terminal Railway has given a mortgage to secure funds for construction and improvements of the line, new yard facilities and terminals. Plans are also under consideration for an extension of the road.

SAN FRANCISCO, IDAHO & MONTANA.—Grading, it is said, has been started on this line from Caldwell, Idaho, on the Oregon Short Line, southwest to Winnemucca, Nev., on the Southern Pacific main line, 196 miles. (Aug. 30, p. 248.)

SARATOGA & ENCAMPMENT.—This road has been opened for business from Walcott, Wyo., south to Saratoga, 24 miles. (May 24, p. 728.)

SEABOARD AIR LINE.—On the Sarasota branch, the sixth division, under construction between Terra Ceia Junction, Fla., and Terre Ceia, 5.4 miles, has been finished and is open for business.

SOUTHERN PACIFIC.—On the Coast division, the Coast Line Railway has been opened for business from Santa Cruz, Cal., to Davenport, 11.4 miles.

SOUTHERN RAILWAY.—Announcement is reported made by this company that, owing to recent adverse railroad rate legislation in some of the southern states, and to general conditions, the double tracking of the road between Chattanooga and Ooltewah Junction, Tenn., and north to Greensboro, N. C., has been suspended. Con-

tracts had been reported made for double-tracking work in Tennessee aggregating several millions of dollars.

STEPHENVILLE, NORTH & SOUTH TEXAS.—This road has been opened for business from Stephenville, Tex., south to Alexandria, 13 miles. (Aug. 30, p. 248.)

TENNESSEE RAILWAY.—This road has been extended from Montgomery, Tenn., south to Smoky, six miles.

TEXAS & PACIFIC.—The Opelousas, Gulf & Northeastern is now in operation from Melville, La., southwest via Opelousas to Branch, 41 miles. Track is being laid south from Branch to Crowley, 15 miles, and this section is to be opened for business September 15. This extension is ultimately to be built to a point on the Gulf of Mexico. An extension is also to be built from the northern terminus to a point on the Mississippi river.

TONOPAH & GOLDFIELD.—This company recently finished the Bullfrog-Goldfield line from Goldfield, Nev., south to Bullfrog and to Rhyolite, 81 miles. An extension is projected from Gold Center, near Bullfrog, south to Greenwater, Cal., about 50 miles. (May 31, p. 760.)

UNION CENTRAL.—Incorporated in Texas with a capital of $225,000 and office in Dallas, to build a line from Dallas, Tex., southeast through Kaufman, Henderson, Anderson, Cherokee, Nacogdoches, San Augustine and Sabine counties to the Sabine river, on the Louisiana state line, 225 miles. The incorporators include: W. J. Hogue, W. R. Stout, W. S. Maple, M. C. Gillette, of Dallas; W. H. Marsh, of Tyler; T. B. Poindexter, J. J. Stubbs, of Wortham; J. B. Gordon, Fairfield; H. H. Hyde, Houston, and James A. Lucas, Edgewood.

WICHITA FALLS & NORTHWESTERN.—This company, which was incorporated last year to build a line from Wichita Falls, Tex., northwest to the Red river, thence through Oklahoma to Mangam, Okla., 90 miles, is now in operation from Wichita Falls north to Kell, Okla., 27½ miles. It is reported that the directors recently decided to issue bonds to secure funds to finish the 32 miles of line between the Red river and Frederick, Okla.

YOUNGSTOWN & OHIO RIVER.—This company has given a mortgage to secure funds, of which $1,500,000 will be used to cover the cost of construction. The line is building from Salem, Ohio, to East Liverpool via Lisbon, and will operate into Youngstown over the Youngstown & Southern. The company has leased the Pittsburg, Lisbon & Western from Salem to Washingtonville, seven miles. The Youngstown & Ohio River is being built by the Cleveland Construction Company. It is to be in operation by December of this year. (March 15, p. 394.)

RAILROAD CORPORATION NEWS.

APALACHICOLA NORTHERN.—E. A. Faulhaber, of St. Louis, Mo., has been appointed Receiver of this road, which runs from River Junction, Fla., where it connects with the Atlantic Coast Line, the Seaboard Air Line and the Louisville & Nashville, to Apalachicola, Fla., 80 miles.

ARKANSAS VALLEY.—See Atchison, Topeka & Santa Fe.

ATCHISON, TOPEKA & SANTA FE.—At the annual meeting on October 24, the stockholders will be asked to ratify the lease to this company of the Fresno County Railway and to ratify the purchase of the Arkansas Valley, the Holly & Swink and the Eastern Oklahoma. These companies have been controlled through stock ownership.

BROOKLYN RAPID TRANSIT.—See Coney Island & Brooklyn (Electric).

CANADA ATLANTIC.—The stockholders will vote on September 24 on the amalgamation of this company with the Grand Trunk, which bought it two years ago. The road runs from Depot Harbor, Ont., to the Vermont state line, 400 miles, and leases or controls 58 miles of branches.

CANADIAN NORTHERN.—The Dominion Securities Corporation, Toronto, and William A. Read & Co., New York, are placing an issue of $1,500,000, series O, equipment trust 4½ per cent. notes issued by the Imperial Rolling Stock Company, a subsidiary of the Canadian Northern. The notes mature in 10 equal annual instalments beginning June 1, 1908, and are secured on 750 box cars, 170 dump cars, 140 flat cars, 25 cabooses, four snow plows, 21 ten-wheel locomotives and 29 passenger train cars.

CHICAGO, BURLINGTON & QUINCY.—A quarterly dividend of 2 per cent. on the $110,839,100 capital stock has been declared, raising the annual dividend rate from 7 per cent. to 8 per cent. An extra dividend of 6 per cent. on the stock was also declared; both are payable October 1. The new rate will pay the Great Northern and the Northern Pacific, who own nearly all the stock of the C., B. & Q., for their expenses in paying the interest on the joint 20-year, 4 per cent. collateral bonds which they issued in 1901 in exchange for that stock; the extra dividend just declared repays the two companies for the difference during the last six years between the interest they paid and the amounts they received in dividends. The bonds were exchanged on the basis of $200 in bonds for $100 in stock.

CHICAGO GREAT WESTERN.—President Stickney, on his recent return from England, said that plans were nearly completed for new financing which would take care of the needs of the company for the next 10 years.

CONEY ISLAND & BROOKLYN (ELECTRIC).—The stockholders of this company, which is a subsidiary of the Brooklyn Rapid Transit, have agreed to forego the dividends for the next two years in order to pay for improvements. The quarterly dividend was passed last spring. (May 10, p. 664.)

EASTERN OKLAHOMA.—See Atchison, Topeka & Santa Fe.

FORT WAYNE, CINCINNATI & LOUISVILLE.—See Lake Erie & Western.

GRAND TRUNK.—See Canada Atlantic.

GREAT NORTHERN.—At the annual meeting on October 10, the stockholders are to act on a proposition to buy all the properties of the following companies which make up the system: The St. Paul, Minneapolis & Manitoba, the Eastern of Minnesota, the Willmar & Sioux Falls, the Park Rapids & Leech Lake, the Minnesota & Great Northern, the Duluth, Watertown & Pacific, the Dakota & Great Northern, the Montana Central, the Duluth, Superior & Western Terminal, the Montana & Great Northern, the Billings & Northern, the Spokane Falls & Northern, the Columbia & Red Mountain, the Washington & Great Northern, the Seattle & Montana, the Minneapolis Union Railway and the Duluth & Superior Bridge.

HOLLY & SWINK.—See Atchison, Topeka & Santa Fe.

INTERBOROUGH-METROPOLITAN.—The quarterly dividend of 1¼ per cent. on the $45,380,300 cumulative preferred stock due October 1 has been passed. No action has yet been taken on the 7 per cent. dividend on the Metropolitan Street Railway stock guaranteed by the New York City Railway, but the usual quarterly dividend of 2¼ per cent. has been declared on the stock of the Interborough Rapid Transit. (Aug. 30, p. 248.)

INTERBOROUGH RAPID TRANSIT.—See Interborough-Metropolitan.

LAKE ERIE & WESTERN.—At the annual meeting on October 2, the stockholders will vote on the proposed merger with this company of the Fort Wayne, Cincinnati & Louisville, which runs from Fort Wayne, Ind., to Connersville, with a branch from Newcastle to Rushmore, 129 miles in all.

METROPOLITAN STREET RAILWAY.—See Interborough-Metropolitan.

NATIONAL OF MEXICO.—Arrangements have been made for extending the $8,500,000 outstanding 5 per cent. four-year notes maturing October 1, 1907, being part of an authorized issue of $10,000,000, until April 1, 1909, at the same rate of interest. This extension is at the option of the holders of the notes; they may have the notes redeemed on the original date of maturity, at par, but those who are willing to have them extended will receive new notes and $35 additional in cash for each $1,000 note.

NEW YORK CENTRAL LINES.—Gross earnings for the month of August, 1907, were as follows:

	1907.		Changes.
New York Central & Hudson River	$9,264,420	Inc.	$640,911
Lake Shore & Michigan Southern	4,135,926	"	312,520
Lake Erie & Western	488,666	Dec.	20,570
Chicago, Indiana & Southern	248,516	Inc.	77,837
New York, Chicago & St. Louis	884,757	"	75,188
Michigan Central	2,474,261	"	298,780
Cleveland, Cin., Chicago & St. Louis	2,471,386	"	106,100
Peoria & Eastern	259,136	Dec.	27,047
Cincinnati Northern	95,341	"	19,705
Pittsburgh & Lake Erie	1,519,496	Inc.	261,993
Rutland	293,568	"	6,050
	$22,135,473	Inc.	$1,712,057

TOLEDO, ANN ARBOR & DETROIT (ELECTRIC).—The property of this company, which has been in the hands of a receiver since August, 1906, is to be sold under foreclosure on September 16. The upset price is $80,000. The road is partly built between Toledo, Ohio, and Ann Arbor, Mich.

UNION PACIFIC.—The syndicate headed by Kuhn, Loeb & Co., New York, which underwrote the $75,000,000 convertible 4 per cent. 20-year bonds last spring, expires on September 16. The last instalment was paid on September 10, and it is understood that this amount, which was about $30,000,000, was at once used to take up the notes issued to the Pennsylvania for Baltimore & Ohio stock. It is said that the syndicate disposed of only about 2½ per cent. of the bonds.

WESTERN PACIFIC.—It is said that this company has acquired control of the Yosemite Valley Railroad, which was recently opened for traffic from Merced, Cal., to Yellowstone Park, 85 miles.

YOSEMITE VALLEY.—See Western Pacific.